COMMONWEALTH OF PENNSYLVANIA.

DEPARTMENT OF AGRICULTURE.

BULLETIN NO. 152.

FRUITS FOR PENNSYLVANIA.

BY

DR. J. H. FUNK, BOYERTOWN, PA.

1907.

HARRISBURG, PA.:
HARRISBURG PUBLISHING CO., STATE PRINTER,
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man will easily break a ton of ears in less than three hou
has been argued as an advantage in favor of grinding that c
seed meal or oil meal can be mixed readily with ear corn.
this is true it has been found just as satisfactory to put cotto
meal on top of the broken corn as to mix it with it. In thi
the feed will be fairly well mixed by the cattle when eaten. A
advantage in favor of broken corn is that a greater amount
undigested corn will be recovered by hogs if they have ac
the steers. Where corn must be shipped in, it of course
shelled on account of the freight. It might be better ground
steers will not chew the shelled corn so well as the broken ear

These are but a few of the questions connected with beef
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would indicate its profitableness. It is
feeding is advisable, except for young a
But that we can produce baby beef and
ntage is firmly believed.

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A. L. MART

etary of Agriculture and Director of Insti

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VIRTUE LIBERTY AND INDEPENDENCE

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PREFACE.

There has been a noticeable tendency in recent years to increase the production of orchard fruits in Pennsylvania. The adaptation of our soils and climate to fruit production has always been apparent. The farm orchard, where fruit enough was grown to meet the wants of the farmer's family and leave some to be sold to neighboring villagers, has had its place ever since the first settlers began to establish farm homes. It has only been in recent years, however, that fruit production for the markets of our own large cities and for exportation, has occupied the attention of our people. As attention has turned to the possibilities to be achieved in this direction, inquiry has been raised as to the varieties of the various orchard fruits adapted to our State, methods of planting, pruning, fertilizing, cultivation, etc., and in order to meet such inquiries and present the information sought for in the most practical way, this Department engaged one of our own citizens, whose work, as it may be seen in his own extensive orchards, speaks for itself, to make the necessary investigation as to adaptation of varieties of fruit to the different sections of the State, and to prepare a bulletin covering as nearly as can be in a work of this size, the entire subject of successful fruit production in Pennsylvania.

It is now sent out in the hope that it may prove helpful to those already engaged in fruit production, and that it may be the means of inducing others to attempt an increase of income in the same way.

N. B. CRITCHFIELD,
Secretary of Agriculture.

FRUITS FOR PENNSYLVANIA.

By Dr. J. H. Funk, *Boyertown, Pa.*

INTRODUCTION.

In obedience to the desires of Hon. N. B. Critchfield, Secretary of Agriculture of Pennsylvania, I have the pleasure of presenting my views on Horticulture in Pennsylvania. Specifically, I fear that little of professional information will be added to that large storehouse of professional knowledge and skill which characterizes the average up-to-date horticulturist of the present age.

Knowing that these pages will be perused and criticised by men who are past-masters in thoughts and practices of the most up-to-date methods in our respected profession; knowing this, we feel the inspiration to better things. As iron sharpeneth iron, so the contact with great minds brings out new ideas; new thoughts arise. In the attrition of mental manifestation, coherence and system develop, and these nurture the new thoughts to their widest sphere of practical application. To evolve facts, to draw conclusions from data collected, in a manner that will evince our intimacy with nature's processes is the goal of every progressive horticulturist. With all due reverence for the past as containing sacred memories and grievous mistakes, the former should keep us true to ourselves and the latter be the finger-board to direct our future operations. In this future—very near at hand—is an awakening, portentious in extreme, in all matters bearing upon horticulture. There are hundreds of men living, who see nothing good in our day, their spirit yearns for the days of yore. Such men are clogs upon the wheels of progress; they are tied to the past and hence dead to the future. They are unable to see aught of worth in the present, and their future is full of dire premonitions for the man who builds upon the accumulated wisdom of the age.

> "We are marching, we are living, in a grand and awful time,
> In an age on ages telling, to be living is sublime."

Never perhaps in the history of the world have so many knotty problems presented themselves for our consideration. Plant breed-

ing and the many problems it presents; the philosophy of variation, whether the phenomena observed are accidental, or are built upon a great underlying principle, as inviolate in its action as the law of gravity.

The successful horticulturist fully realizes that the work upon which he is engaged requires a store-house of knowledge, as complex as that which must be possessed by a successful man engaged in any of the learned professions. This is a truism, not realized by many. It is the sheet-anchor of our hopes, the touch-stone of every pronounced success.

FRUIT CULTURE IN PENNSYLVANIA.

"Like morning's first light that gladdens the sight,
So may the best fruits spread over the earth,
And when we shall reach that still fairer land
And round the life-tree in mercy shall stand,
May each pluck its fruit, and never more feel
The serpent's sharp tooth, once close at its heel."

That small portion of the earth's surface to which I shall call your attention in this work, known as the Keystone State, consisting of lofty mountains, gently sloping hills, and rich fertile valleys, occupies a position on the maps between 74 degrees, 30 minutes and 80 degrees, 30 minutes west longitude, and 39 degrees, 45 minutes and 42 degrees north latitude. The surface varies greatly in altitude ranging from a few feet to nearly three thousand feet above sea level.

In treating of this particular portion of the earth's surface it is not intended to extol it above any other for any special production, unless it richly deserves it. To ascertain this fact there can be no consideration of its merits to the exclusion of all others; but its adaptability for the purposes under consideration must be determined by a just and impartial comparison of its merits with all other sections of our vast continental domain for fruit raising.

It would be more than folly to give this subject a narrow sectional consideration, or to attempt in this day, when mankind travels by steam and communicates thought by electricity, to try to induce you to believe that in any particular locality in the State of Pennsylvania, there exists the best fruit growing region known to man, when within one day's travel you may pass through sections vastly superior to this. But it is the intention to show the many advantages we have. The favorable climate for the best production of fruit in the very heart of the great apple belt of the world, with the altitude that seems most favorable, with a great abundance of the various soils that have proven to be the best adapted in every state and territory where fruit is planted. Statistics show that we already hold an enviable position in horticulture, being

second in production and on par with the best in quality of fruit, which is one of the essentials, as high civilization demands high culture, with every department of art and science coming to its assistance supported and aided by these coadjutors, horticulture from its very nature, assumes the rank of a fine art, and produces the most valuable food of the highest quality. This pursuit always marks the advancement of a community. The culture of fruits contributes in no small degree to the improvement of the people by the excellent moral influence it exercises upon them. Everything that makes home attractive must contribute to this desirable end. Beyond the sacred confines of the happy hearthstone, there can be no more pleasant associations than those of the vine arbor, the berry patch, and the orchard, with its bounteous supplies of the golden and ruddy cheeked apples, the blushing peaches, and the melting pears, the rich cluster of the luscious grapes garnished at their sides by the crimson strawberry, the very fountain of Hygeia with all the elements conducive to the highest enjoyment of full and perfect health. It is with pleasure we refer to such noted men as Charles Downing, Marshall P. Wilder, Patrick Barry and others who have left behind them a heritage of which we may well feel proud. They laid the foundations on which we build to this day. It is not becoming to forget their valuable instructions but to give them all due credit and follow in their footsteps as far as possible. But conditions have changed. The whole face of our horticulture has changed. The country has grown, and the people have grown with it. The teachings that were considered right and proper for us to follow in those days would mean total failure in our day, as many horticulturists know to their sorrow.

The greatest difference between the old and the new horticulture lies in this: They studied each variety as a definite unvarying entity; we look upon it as a more plastic indefinable quantity. They knew but little of its geographical limits, they knew a variety in a few states, and generally under very uniform conditions. If a variety succeeded in New York and Pennsylvania, they unhesitatingly gave it a general recommendation. If it failed, they condemned it. We have larger areas to cover and we know that a variety is often very choice as to locality. Every year fruit raising is being conducted on narrower lines. We dare not content ourselves with what was once a standard or a favorite in our boyhood days. We must grow varieties which are adapted to our soil, as it means the difference of money in the bank, or a mortgage on the farm.

In olden times, in the memory of a great many of the readers of this work, the purpose of farming was to make a living. If the crops of the year were sufficient to feed the family, the stock, and

give enough available cash for the purchase of clothes and the other necessary articles required for the health and comfort of the family, the season was considered a successful one. The time and labor of the farmer, his wife and children were given with no thought of value, or compensation being set thereon. In very favorable years, or the farmer being above the average in intelligence and thrift, a small surplus was secured, which was carefully husbanded by the farmer and his frugal wife. Small accumulations were added year by year until a neat bank account, or money on interest permitted him to retire from active work on the farm, to live a contented and happy life for the remainder of his days.

But times have changed, or are rapidly changing, and instead of looking upon the farm as a place for the farmer to merely exist, or pass his chrysalis stage, we are now coming to look upon farming as a business. If the crop does not pay, and pay well, for labor and all other expenses, and give a surplus, it is superseded by others that are more remunerative. The purpose of farming to-day is to make money; to make more than a living. Instead of furnishing the mere necessaries of life, it must furnish the luxuries which are considered in our age so necessary for the full and perfect enjoyment of life. It must do more than this. It must lay aside a sinking fund, as a sort of endowment upon which drafts can be made when old age compels the farmer to retire from active business. The farm home should be considered more than a mere money matter, but when we deal with a crop it should be dealt with as a business proposition. This requires a better knowledge of the scientific principles that underlie crop production.

So it is in horticulture. It does not require much science or skill to grow apples enough to supply the wants of an ordinary family, a few bushels through the summer and fall months for eating and cooking, a few barrels to be stored for the winter, a few bushels for the making of apple-butter and jellies, and a few barrels of cider for vinegar and drinking. These fill the demands and satisfy the desires of the average farmer.

But to grow apples commercially, to make a specialty of it, such apples as we see on exhibition at horticultural meetings, the world's fair exhibits, etc., requires the intelligent application of more scientific principles than the average farmer possesses. To grow and market these that the greatest profit may be realized, requires good business judgment as well. Horticulture is a many-sided business: 1, the growing side; 2, the insect side; 3, the fungi side; 4, the packing side; 5, the shipping side; 6, the marketing side. This hexagonal business is becoming annually more complicated. In the early days the farmer raised his fruit with little molestation from insects and

fungi. But those good old days are past, and now to have any fruit at all the grower must give earnest, intelligent attention to the insect and fungi side of the business. He must be an entomologist and a pathologist. He finds that unless he knows the habits of insects and of fungus diseases and the means of checking their ravages he is in a losing business.

The time has come for orchardists to pause and investigate as to the many partial or total failures, as to the productiveness and keeping qualities of the apple. There was a time a few generations back when the orchards were proportionally much more productive than the average orchards of the present time. In those earlier days trees did not receive the care and culture as the careful orchardists now give them. In those days all that was necessary was to plant the young tree and with such care as nature alone gave them bore in a few years abundantly. In traveling through the country we still find those old relics of the past, many of them have stood the hot suns of summer, the cold blasts of winter for one hundred and fifty or more years. Great strong massive trees which not only defy time, but have borne many hundreds of bushels of apples. One prominent feature noticeable in these old landmarks is that they were all top-worked trees distinctly showing where the scion united with the trunk, mostly from four to six feet from the top. In other instances the scion outgrew the trunk, making a decided difference in diameter. I do not propose to enter into the merits or demerits of top-working versus root grafting at this time, as that will be treated later.

In those times, the people, not from choice, but from necessity, lived closer to Nature's laws, and those laws are the same to-day as they were in the past, and as they will be in all time to come. In those times the life of a tree was a hundred or more years. To-day the average is less than one-fourth. It is asserted by knowing horticulturists and proven by statistics that of all the trees planted not one per cent. lives to reach profitable maturity. This seems incredible, yet when we consider the millions of trees sold annually by our nurserymen and look in vain for profitable orchards we cannot doubt its truth. Occasionally we hear of a profitable orchard. When we investigate as to the cause, we find the environments exactly right; soil, varieties, latitude, the man.

This brings us to the point of vital interest, varieties adapted to the latitude. In earlier times people knew no difference, they planted seedlings, top-worked such varieties as originated in their vicinity. There were no tree agents, no nurserymen to introduce foreign varieties, consequently they planted those that were suited to the latitude and the results were, thrifty trees and plenty of

fruit, some of the highest quality, that still stand in the front ranks of honor. We will devote a few lines to the adaptation of varieties to latitude. To many this will be a new line of thought as to what influence imaginary lines running around the earth can have on fruit raising.

ADAPTATION OF VARIETIES TO LATITUDE,

The United States is one of the greatest fruit countries in the world, lying between latitudes 24 and 48 degrees north, and longitude 69 to a 124 degrees west of Greenwich. The lines divide and subdivide the country into sections, districts or zones. Fruit growing, as with all agricultural pursuits, thrives best in certain geographical areas. That is, certain fruits develop to greater perfection in one district than in another. Climate is the leading factor in the distribution of fruit growing. We recognize three general climatical fruit zones—the tropical, semi-tropical and temperate. A very small portion of the United States lies in the tropical zone, from latitude 25 to 27 including Monroe, Dade, Lee and a portion of DeSoto counties, Florida, very little of which is available, as the Everglades and Lake Okeechobee lie within these counties, and a large portion of the balance is very low and marshy, with almost impenetrable bayous, so very little of the tropical fruits will likely be raised.

The semi-tropical zone reaches from latitude 27 to the northern boundary of Florida, south of latitude 30 in Eastern United States, a narrow strip along the Gulf of Mexico, on the western coast in the valley of California it extends as far north as the 40th parallel. This section is one in which the winters are short with occasional freezes and light frosts. But for several years, since the great freeze of 1886, when the citrus orchards were nearly all destroyed, the temperature varies so much that the production of the subtropical fruits is very uncertain. So much so, that hundreds of truckers and fruit raisers were compelled for self-preservation to abandon their homes and move farther north where the climate is less changeable.

The temperate zone is marked by long winters and hard freezing and by the deciduous type of fruit, such as the apple, pear, peach and other hardy fruits. This zone reaches from the subtropical as far north as the 45th parallel in the eastern portion, but as we go westward through the middle states the limit falls; as we approach the western coast it again rises.

There are three factors in determining the temperature of a section, the latitude, the altitude and lying adjacent to a large body of water. But all deciduous fruits do not do well over this large range. Certain types of peaches, such as the Peento and honey-type, do best in the subtropical; they are not hardy north

of the 31st parallel. The farther north the hardier must be the type; varieties of the North China and other hardy types can be planted as far north as New York and Michigan and produce profitable crops.

The apple planted south of latitude 33 amounts to little; when planted below 30 degrees of latitude it is worthless. It becomes an evergreen, and does not know how to behave, blooms, but sets little fruit; such as does adhere fails to come to proper maturity and lacks quality.

The pear does little better, none but the oriental varieties doing well south of latitude 32; the apple does well from latitude 35 to 55 degrees. But all varieties do not equally do well over this entire area. To prove this we will start far north, taking Russia as an example. Of the many importations into the United States with the expectation of getting long keeping varieties, every one has proved a failure, as every variety, no matter how late a keeper in Russia, when brought to the United States matured earlier and became a fall fruit; when planted south of latitude 40 became a summer fruit.

So we find with the apples originating in our own country. We have a fruit belt between latitude 41 and 45 degrees north which produces several varieties of splendid winter apples, such as the Baldwin, R. I. Greening, Northern Spy, King, Rox Russet and others, which are perfectly adapted to these latitudes and are very profitable. But we have another belt, calling for different varieties. This is south of latitude 41, running through Pennsylvania, Ohio, Illinois and Missouri, then southward to latitude 35 degrees, thence along the same to the Atlantic coast. We have a much larger belt than our northern friends and it will not be long before this belt lying south of 41 degrees becomes, if it is not already, the great apple producing belt of the world. The secret of varieties adapted to latitude can be given in a few words. All fruits brought from a cold to a warmer climate mature earlier. All varieties brought from a warmer to a colder climate mature later. Therefore if we wish success we must plant varieties originating in our own latitude or south of us. There is not one variety known that originated north of latitude 42, or even 41 degrees that is a long keeping winter apple when planted south of 40, unless the difference is made up in altitude which is one of the influential factors in the production of fruit.

Before leaving this subject, I wish to throw a few rays of light that may guide the fruit raiser along the thorny road of success. All effects are the products of causes. All products are the result of conditions. Soil is necessary to produce fruit. The quantity

and quality of the fruit produced depends greatly on the ingredients and condition of the soil. All the earth's crust is soil; hence, all the earth's crust should bear fruit. But practical results and logic do not always agree. Experience teaches us that one soil will grow and mature fruit to perfection and that other soils will not. Again, the same variety of soil that will produce fruit to perfection in one locality, will not do so in others, even though analysis shows it to be chemically the same. Why is this? It is plain to be seen that soil is not all that is necessary. Something more is wanting; atmosphere, we must have atmosphere of a certain composition in conjunction with the soil to produce fruit to perfection.

Atmosphere has been the principal agent in changing the surface of the earth; by first disintegrating the rocks, then, in connection with solar heat and moisture germinated and started the growth of vegetation, for the sustenance of the animal kingdom and finally fulfilling all the functions necessary for the development of all forms of life. The atmosphere consists of a mixture of three gases —oxygen, nitrogen and carbonic acid—but not always in the same proportion. When it varies the product also varies. This variation is more or less dependent upon altitude. The oxygen is always found in two different conditions according to circumstances of altitude; one being the natural state or ordinary oxygen, the other its active principle or condition when it is called ozone. Where much ozone exists fruit grows to the highest state of perfection.

Many call this atmospheric condition climate. They ascertain the temperature as recorded by the thermometer, where certain apples or peaches are raised, and the latitude, the variety of soil, then select some location to their liking, where the environments are apparently the same and confidentially expect to raise these fruits to perfection, only to meet with disappointment and total failure. Why is this? The soil was chemically the same, the parallels of latitude the same, the climate as indicated by the thermometer the same, why then should there be failure? The cause of failure was the atmospheric condition-difference in altitude. The atmosphere, while always composed of the three gases—oxygen, nitrogen and carbonic acid— yet varies in proportion in different localities. It also varies in its electrical and other conditions, according to the distance above sea level, until you reach a point where neither vegetable nor animal life can exist.

The mountains have their timber lines above which no timber ever grows. The various deciduous trees, and the grasses, all have their lines of altitude, above or below which they cannot flourish, because the atmospheric food essential for their growth is only found

in these lines of altitude. So it is with the peach, apple, pear, apricot, and other fruits, they will not thrive unless they have both the atmospheric food and soil which their natures require. Similarities of latitude, climate, and soil, without the atmospheric condition obtained by altitude or the proper atmospheric condition without the proper soil will not answer; both must be present in quantity and quality to supply the food required by these kinds of fruit.

ALTITUDE.

This is a very important factor in fruit raising in several ways. Fruits adapted to colder climates may often be successfully raised several degrees farther south, when this difference is made up in altitude, by planting on high lands several hundred feet above sea level. Such apples as the Baldwin, the Greening, etc., which are adapted to that section lying north of latitude 41 may be successfully raised south of 40 degrees, by taking advantage of this fact and planting on very elevated land.

It has the farther advantage of tempering the atmosphere by giving air drainage. The air is rarely if ever perfectly still. This is illustrated by frosts, which touch here and there where the air is stillest, or the radiation most rapid. This is particularly true during the spring and fall months, when the earth becomes very warm during the day and loses its heat rapidly at nightfall. The behavior of frosts is very remarkable, often ruining the crops of one field or the fruit of one orchard and leaving the other (those situated apparently the same) entirely unharmed; often a portion of the same field or orchard only is affected. This is doubtless due to the varying motion of the air. This is noticeable by watching a column of smoke on a calm day as it sways and drifts about in different directions. The air being invisible does not show these movements. It is due to the agitation of the air that we owe our safety from frosts on hillsides. The air as it becomes more dense by cooling, drains off, running down the hillsides into the valleys, and as its vapor condenses gives rise to fogs. It lies in the low places and may give rise to frost. The difference in temperature is very noticeable when riding over a hilly country on a summer night—the air being much chillier in the valleys. It is owing to this fact that rolling or sloping land is more immune from frosts. Consequently, he who uses judgment in the selection of the sight for planting the tenderer varieties of fruits, will have success far beyond his neighbor who has selected the richer bottom lands.

The conditions of the ground also affect the frost, whether it is dry or moist, whether in grass or freshly plowed land, or whether there are trees or pasture surrounding it, all these have their in-

fluence. Many of these apparently trivial features that do not appeal to the ordinary farmer or fruit grower as of any importance, exert a great influence upon the quiet movements of the air.

A strawberry field may be upon a gentle slope sufficiently elevated to be safe. But there is a wood upon the upper side. On visiting the field after a frost you will find the only part affected will be a strip of 40 or 50 feet close to the wood. Most people think this should be a protection, but it is just the reverse. Never plant any tender fruits close to a wind-break but keep a distance away. Why is this? It is because the slight movement of the air down the hillside in passing over the trees is deflected and strikes obliquely downward from the tree tops leaving a dead air belt against the timber, and as frost affects only still air this space suffers.

No one ever saw a frost on a windy night. Winds mix up the air and bring it all to a uniform condition. The slightest impediment, such as a bush, a stone fence, or a bank of earth may be sufficient to retard the movement of the air drainage and the plants nearest the obstacle be frosted. A few feet elevation unobstructed, frequently show an equal number of degrees rise in temperature. There is a limit to the beneficial influence of elevation. When you get beyond that limit what you have gained by atmospheric drainage you lose by the coldness of the elevation, for very high elevations are colder in temperature than lower areas. A ravine or a depression running through an orchard often saves the bloom or small fruit from frosts by carrying the cold air away.

Influence of Deep Lakes and Rivers. Larger bodies of water are also very beneficial in protecting fruit and tender plants. They moderate or temper the severity of the cold by the large surface of warmer water presented. This is the reverse to the previous rules, and the banks of such streams or lakes afford the best sites for the production of tender fruits. They also prevent the buds from starting so early in spring, when we frequently have a few warm days, by chilling the atmosphere. They also afford a protection by the screen of fog which they spread before the morning sun. We frequently see trees bending beneath their loads of fruit in the valleys and on the borders of these lakes, when a few miles beyond their protecting influence, the same varieties are all destroyed. Were it not for this influence, the large crops of peaches would not be raised on the southern shores of Lake Ontario, or northern Ohio, bordering on Lake Erie, and in western Michigan, adjoining Lake Michigan. But these large bodies of water hold so much latent heat that they vary but little in temperature. The land lying in close proximity is warmer in winter and cooler in summer. The larger the lake or stream and the greater the depth, the more ameliorating effect it

has upon the temperature. Of the two, depth seems to have a greater influence than surface exposure. As many of the lakes of central New York are narrow, but very deep, yet they afford equal protection to some of the larger bodies of water having less depth. The lay of the land on the shores also has its influence; where they slope gently back a greater area is protected, often ten to twenty miles feel their protecting influence; whereas, if their banks rise more abruptly, their influence will cover a narrower strip. The area protected depends upon two factors—the distance from the water and the elevation. Two hundred feet being the limit, should the altitude reach higher, all beyond will be unprotected. That large bodies of water have a marked influence upon climate as the peculiar conditions is evident. Statistics show that the annual rainfall is greater on the steep declivities than on the water plains, and that the mean annual temperature is lower upon the hills than it is near the lake. It is supposed by many that frost protection is due more to retardation of bloom until danger from frost is past. In the selection of sites it is well to remember that perfectly flat lands are nearly always frosty because there is no atmospheric drainage. On the other hand, very high lands are also frosty because the air is drier and rarer, and therefore allows rapid radiation of heat from off its surface and they are exposed to cold, rapid winds. The local altitude of fruit lands can be best determined by actual experiment, but in this state, as in all northern states, the best elevation is from a few feet to three hundred feet above the surrounding land or lakes or rivers.

FRUIT IN GENERAL.

The fruit industry of the United States presents several phases of the utmost importance to its citizens, the principal ones are its value as a promoter of health, where it becomes a necessary product. In value as a luxury, and as a money crop, it stands preeminent.

AS A PROMOTER OF HEALTH.

It is of far greater value to man than any other. Fruit has, in the past, been looked upon as a luxury, an article that could be dispensed with. But good fruit of various kinds, in their season, are now looked upon as a necessity, an aid to the proper utilization of the heavier food materials, and for invigorating the various organs of the body so they may best meet the demands made upon them and properly store up materials for repairing all wastes resulting from bodily efforts. It is an established fact that fresh ripe fruit does enable the system to utilize other food materials, and causes the

organs to act with more vigor. Our people should use more fruit, and they would find it an economical article of diet and much more palatable than many of the heavier foods. For children it is especially required during the long, hot summer months, possessing various acids and alkalies in the proper dilute proportions, being mildly laxative, cooling and sedative in their effects, they ward off fevers and the many ailments to which children are addicted, and thus save many times their cost in avoiding doctors' bills.

AS A LUXURY.

There is no article that is so acceptable to the average individual, whether in vigorous health, or the delicate invalid, as good, ripe fruit. It is far more refreshing than any fermented beverage, and more nutritious than the choicest pastry or confectionery. What a variety of delicious dishes can be prepared from fresh fruits, or from the evaporated or canned product that keeps in such perfect condition long after its natural season. It matters little what time of the day it is used, whether before or after the midday meal, as a light lunch between meals, or before retiring in the evening. With what pleasure do we look back after a lapse of fifty years to our boyhood days when we watched for the first ripe fruit. It was no hardship to climb to the top of the highest tree after a red-cheeked apple, or pear. And what fond recollections we have of the home, when, on cold winter evenings, we gathered around the cheerful wood fire, and on the table sat a large platter filled with beautiful red-cheeked pippins, the delicious smokehouse, the janneting, the russets, and the great large fallawaters. And we had the unrestricted privilege of helping ourselves to the largest apple on the plate, for the bins in the cellar were filled to overflowing with more of the same kind. And now, when I am raising fruits of all kinds by thousands of bushels, fruits of the best improved varieties, beautiful to look upon, delicious to the taste, I still look back with longing for the fruits of my boyhood, when the old choke pear, the bell pear, and some of the old-fashioned apples were far more delicious to my palate than are the juicy Bartletts, or the spicy Seckels, or the Winesaps or Jonathans of the present time; but when I taste those same fruits now, I wonder why it is they no longer satisfy—they seem to have lost the delicious flavor they then possessed. Is it so? Or, has my taste been cultivated to a higher standard? If these same old varieties were given to the thousands of poor children in the slums of the large cities, they would be ambrosial to their tastes; so the change must be in the people and not in the fruit.

AS A MONEY CROP.

The vast importance of the fruits produced in the United States may be obtained when we consider the large area planted to the

many different varieties of fruits. Statistics show that in 1900, when the census were taken, that there were nearly three hundred millions of apple trees planted, and nearly two hundred millions of bushels of apples were produced. Nearly one hundred millions of peach trees were planted, producing nearly sixteen million bushels of fruit; two hundred millions of grape vines, producing 1,200,000,-000 pounds of fruit; other varieties of fruits were in proportion.

The Southern states and California had their proportion in oranges, lemons, pineapples, prunes, etc. When the next census is taken we will see that the area planted will be enormously increased and the crops proportionately so.

But, with all the increase in production, we find the demand increases still more rapidly for fine fruit. Prices are steadily advancing; there is never a glut of choice fruit, it is only the poor fruit, such as should never have been shipped, that begs for a market.

FOREIGN MARKETS

Are demanding the products of our orchards, and if this demand is properly nurtured, it will grow so rapidly that it will take all the surplus not consumed by our own population. Millions of barrels of apples are now being shipped annually to Europe, the larger proportion going to England; but even Germany will soon lay aside her prejudices and become large consumers of our fruit, which is noted as being the finest in the world.

When our methods of transportation are perfected, other varieties that are now considered too perishable will be exported also. The demand for evaporated fruits is also increasing in the foreign markets. In this condition these products can be kept indefinitely; many millions of pounds are shipped annually. In one single year over thirty millions of pounds of evaporated apples alone were exported from the United States to foreign countries. Canneries are kept busy putting up our surplus fruits in seasons of great plenty, thus avoiding the great waste of former times. Some of our finest fruits are those that ripen at seasons when there is no market for them, but are now saved by canning and evaporation.

FUTURE PROSPECTS OF FRUIT GROWING

Is brighter and more encouraging now than at any time in the history of our country. The rapid increase of population and wealth must lead to proportionate increase in the demands for native fruits. Provided the growers are wise enough to produce the most attractive fruits of the highest quality, this combination is a necessary one; uniformity and high color to attract the eye, and high flavor to create an unsatisfied desire for more, and it must be put up in an

attractive manner, this will help to increase the demand, and increase the price. Fruit of poor color, put up in unattractive packages, finds a poor market at unremunerative prices. The more choice fruit the people have, the more they want. The more poor fruit upon the market, the less the demand.

Two sets of factors chiefly control and determine the outlook of the fruit grower: The personality of the grower, and the prospective condition of the markets. Few people appreciate how personal a thing success is; yet everyone knows that any two persons put in the same physical and environmental conditions, and given an equal chance, will arrive at very various results in business. The real directive forces are matters of character and personality, of which the most important requisite seems to be love of the business, indomitable energy, cool judgment, and sterling honesty. It is indisputable that there is always a demand for the best. There is not enough of the best in any commodity. A man cannot produce the best unless he has the ability for it. On the other hand, there is generally a surplus of the ordinary. In fact, it is this feature which makes it a surplus. As most men are ordinary, it follows that most of their products will be ordinary. From this we can draw inference that the great majority of fruit raisers can never really succeed. This demands that we define what is commonly meant by the best. That kind of fruit usually sells best of which there is the least. It may not be intrinsically the best. It is simply that which has the least competition. The key to the business is, therefore, diversification, or individuality. The grower should aim to grow something that his neighbors do not grow.

The grower need have no fear of success if he grows what the people want, or puts it up in such attractive form as to make them believe they want it. In its common form, fruit raising, as in many other kinds of business, is overdone, and there is often little or no money in it, especially in years of full crops when everyone has a surplus. The year following is generally a year of scarcity, prices rule high, the majority have nothing to sell. The last thing the average fruit raiser learns in respect to his business is to thoroughly master local conditions. The grower who has made a compromise with nature, and relieved her of part of her burden and strenuous labor the previous year, by removing a fair proportion of fruit from the overburdened branches, has so changed the environments that he will receive a good crop in the so-called off-year, and thus be master of the situation. His orchard will become an annual bearing one; he will get high prices one year because of scarcity; he will get good prices the next season because his trees being not overburdened produce fruit of the finest quality, for which there is always a demand. It may be stated as a general principle, that the com-

mercial outlook is the best in those fruits which readily yield to the greatest number of secondary or manufactured products. In these fruits the grower is not dependent upon a single outlet for his crop. It often happens in years of plenty that the outlet is not sufficient to dispose of a perishable crop in the fresh state. This truth is well illustrated in the Eastern grape business; this fruit is consumed principally as a dessert fruit, and the markets frequently become so overstocked that the fruit scarce pays freight charges. With apples and peaches the grower has the alternative of canning or drying that portion of his crop for which there is no demand in the fresh state.

In the very near future I believe that fruit raising will become a specialty; the small, indifferent grower and the farmer will be forced out of the business, not by trusts, or individual growers, but that terrible pest, the San José Scale, that is making such sad invasions into the farm orchards, thousands of trees being destroyed annually. But this insect will be treated under another head.

PROPAGATION.

All plant life must depend upon one of two sources—seed or bud—and they are very closely related. The seed has within itself parts which are capable of being developed into the individual parts, as root, stem, leaves, etc., but they have yet to be developed. The different parts as we find them in the seed are merely the representative parts. But the seed has the future tree within itself. Within the bud, still more plainly and more distinctly visible, is the future tree manifest, and we may produce a tree from a bud as certainly as we do from a seed. With the proper environments it will develop roots, stem, branches, leaves, etc., the same as the seed, with this difference: From the bud we have the assurance of always producing the duplicate of the original, thus perpetuating its kind; whereas the seed propagates a new individual that may differ widely from its parent. The former is only a new development of a part of a previously existing organism. The similarity between the two is so close that it is a matter of great importance to the horticulturist. Every bud of a tree is an individual tree. Men of science recognize the individuality of buds. In the seed we have the new tree produced by the agency of the sexes, and developed with the seed. A leaf bud is a young plant produced without the agency of the sexes, enclosed within the rudimentary leaves called scales, and developed on a stem. Seeds propagate the species, leaf buds propagate the individual.

PROPAGATION FROM SEED.

In the development of a plant or new tree from the seed, it is necessary to go through the process called germination; after the plant is formed and its growth is carried on through the agency of its leaves, the process is called vegetation.

To produce germination, the seeds require heat, moisture, and air. When seeds are planted and these three requisites are present, they quickly germinate, but should any one be absent, they either lie dormant until conditions are favorable, or perish. Should the seed be too dry, there is not sufficient moisture to swell and soften it; if too wet, it frequently rots; if too cold, it either lies dormant or rots. It will be observed that these three requisites are present when seeds are slightly buried in moist, warm, mellow earth. Heat, although essential to all seeds, varies in degree required by different species. It is often necessary to bury seed to considerable depth to get sufficient moisture to start them. On the other hand, they will germinate on the surface if kept constantly wet.

Air is the third requisite. Should seeds be planted too deep, they fail to germinate; peach pits are sometimes kept over the year by burying them a foot or more in the soil. We know many seeds, such as clover, frequently lie dormant for years, but when they are brought near the surface they germinate. The seeds of noxious weeds often remain dormant for years, buried beneath the soil, until cultivation brings them up and mixes them with the soft, mellow earth, accessible to air, when they spring up in profusion.

As a general rule, seeds germinate and grow most readily when they are buried to a depth of from three to five times their diameter, in soils of ordinary moisture. The first noticeable change in the seed after it has absorbed a large amount of moisture is to swell and become soft; we see the germ enlarging beneath the seed coat, shortly the integuments burst and the radicle appears, after the plumule becomes manifest, the radicle buries itself in the soil, the plumule ascends into the atmosphere and seeks exposure to the direct light of the sun.

The ascending plumule shortly unfolds new leaves, and, if coming from the seed of a branched plant, lateral buds make their appearance. The radicle divides and subdivides in beginning the issue of true roots.

All plants whose seeds readily divide into two parts, and whose stems increase externally by addition of new rings of growth—the so-called Dicotyledonous plants—have at first a single descending axis, the tap root, which penetrates vertically in the ground. From this central tap root lateral roots branch out more or less regularly, and these lateral roots subdivide again and again.

The firmness with which a plant is fixed in the ground depends upon the nature of its roots. A seedling apple tree which has a tap root withstands strong winds much better than a transplanted tree in which the tap root has been destroyed and has only side roots for its support.

THE STEM.

The next stage of plant or tree development, after root formation, is the stem. It has, in general, an upward direction, which, in many plants, is permanent, while in others it falls to the ground, and thereafter grows horizontally. All plants of the higher order have stems. In general, the functions of the stem are subordinate to those of the organs which it bears—the leaves and flowers. It is the support of these organs, and only extends in length and thickness for the purpose of sustaining them.

BUDS.

In seeds the stem exists in a rudimentary state, associated with undeveloped leaves, forming a bud. The stem always proceeds from a bud, and during all its growth is terminated with a bud at every growing point, and only ceases being thus tipped when its growth is finished and it has performed its function by the production of seeds.

In the leaf bud we find a number of embryo leaves in close contact and within each other, but all are attached at the base to a central, conical axis. In the flower bud the same structure is manifest, except that the rudimentary flowers and fruit are enclosed within the leaves, and may be seen by cutting open the bud. The peach bud shows this quite plainly.

LATENT BUDS.

Many buds remain undeveloped, either permanently or for a time. Most of the side buds of our fruit trees fail to grow. When active buds are by any means destroyed by frosts or by pinching back, other buds that would otherwise remain dormant are pushed into growth. These are Nature's reserves, whereby she can again form new heads and laterals in case of injury. The horticulturist takes advantage of this and molds his trees in any shape or form he desires, by removing branches and buds, and thereby not only checks excessive growth, but also calls forth development of the part before suppressed.

Adventitious buds are produced from the stems, as well as from the older roots, when they are mechanically injured during the growing season. Several varieties of trees, when cut down, throw out buds and new stems from the stump, such as the chestnut, etc.,

while locust, cherry and some others, form adventitious buds, or subterranean branches similar to the root stock. These coming to the surface are termed suckers. The stem is divided into several parts. The *bark, or rind.*—This is the external covering; like the pith, it becomes sapless and dead in perennial plants and trees, and, after a time, falls away, although in the oaks and many other forest trees it remains many years. Beneath the covering comes the cambium; it is the seat of growth by cell formation. This is found between the outer rind and the wood. It is the circulating medium through which the sap flows. There is no definite limit where wood ceases and bark begins. In the Spring and early Summer the new cells that form in the cambial region are very delicate and easily broken. Owing to this, the bark may at this season be easily stripped off, whereas, in late Fall these cells become thickened, full-grown bast and wood cells, when it is impossible to peel the bark.

Wood, or woody fiber, consists of long, slender cells of various forms and dimensions, which are delicate when young (in the sap wood), but, as they become older, fill up interiorly by the deposition of repeated layers of cellulose, which is intergrown with a substance called lignin. To this the stem or trunk of the tree owes its stiffness and strength. In the forest trees this is the valuable part from which our lumber is sawed.

The stems of our perennials after a few years show a series of rings corresponding with the number of years of its growth. The annual cessation of growth which occurs at the approach of Winter is marked by the formation of smaller or finer wood cells, while the vigorous renewal of activity in the cambium at springtime is marked by the growth of larger cells.

LEAVES.

These are the most important organs of the plant or tree. They are at first folded curiously together in the bud, and afterward expand so as to present a great amount of surface to the air and light. The leaf consists of a thin membrane of cell tissue arranged upon a network of fibers and ducts. It is directly connected with the cambial layer of the stem or twig.

One peculiar characteristic of almost all leaves is, that as long as they are in healthy, active service they contain a green coloring matter giving them a green color. This is also present in the bark of the new growth, and in these it performs the same function as it does in the leaves. When a tree or plant, through lack of nutriment or moisture in the soil, or by some other means, becomes diseased, it loses its green color, becoming yellow; and at the approach of Fall, when growth ceases, leaves lose their color and soon drop.

The leaves are also covered with vast numbers of breathing pores, by means of which the intercellular spaces brought into direct communication with the atmosphere. The greater number of these pores are situated on the under surface of the leaves of trees and land plants. On water plants they are mostly on the upper side. In number and size they vary considerably, some having as few as 800, while others have as many as 170,000 to the square inch. About 100,000 may be counted on an average-sized apple leaf.

The offices of the foliage are to put the plant in communication with the atmosphere and the sun. On one hand it permits, and to a certain degree regulates, the escape of the water which is continuously pumped into the plant by its roots; and, on the other hand, it absorbs from the air, which freely penetrates it, certain gasses which furnish the principal materials for the organization of vegetable matter.

We have seen that the plant consists of elements, some of which are volatile at the heat of ordinary fires, while others are fixed at this temperature. When a plant is burned, the former, to the extent of 90 to 99 per cent. of the plant, is converted into gasses; the balance remains as ashes.

The reconstruction of vegetation from the products of its combustion (or decay) is, in its simplest phase, the gathering by a new plant of the ashes from the soil through its roots, and of these gasses from the air by its leaves, and the compounding of these comparatively simple substances into the highly complex ingredients of the vegetable organism. Of this work, the leaves have by far the larger share to perform; hence, the extent of their surface and their indispensability to the welfare of the plant.

The assimilation of carbon in the plant is most intimately connected with the chlorophyl, which has been noticed as the green coloring matter of the leaf and depends also upon the solar rays.

REPRODUCTIVE ORGANS OF THE PLANT.

The Flower.—The onward growth of the stem or its branches is not necessarily limited, until from the buds, instead of leaves, only flowers unfold. When this happens, as is the case with most annual and biennial plants, raised on the farm or garden, the vegetative energy has usually attained its fullest development, and the reproductive function begins to prepare for the death of the individual by providing seeds which shall perpetuate the species.

There is often at first no apparent difference between the leaf buds and flower buds, but commonly in the latter stages of their growth, the latter are to be readily distinguished from the former by their greater size, and by their peculiar shape and color. The flower is a short branch bearing a collection of organs, which, though

usually having little resemblance to foliage, may be considered as leaves, more or less modified in form, color, and office. The flower commonly presents four different sets of organs, viz.: Calyx, corolla, stamens, and pistils, and is then said to be complete, as in case of the apple and many other plants.

The Calyx is the outermost floral envelope. Its color is red or white, or generally green. It is the framework and support of the corolla and is also the protection of the more delicate organs of the bloom.

The Corolla are the series of leaves situate within and above the calyx. They are very seldom green, usually of some bright color. They are the portion that gives beauty to the flower, and doubtless for a wise purpose, to attract the honey-bee and other insects, to aid nature in fertilizing the bloom. When the corolla are divided into separate leaves they are generally called petals.

Stamens are generally slender thread-like organs terminated by an oblong sack, the anther, which when the flower attains its full growth, discharges a fine yellow or brown dust, the so-called pollen.

Pistil, or Pistils.—In the stone fruit there is but one pistil, being all that is necessary, as there is but one kernel or seed, but in other fruits, as the apple or pear, there are five pistils, corresponding with the number of ovaries or seed pods in which are found the ovules or rudimentary seed. Some plants have very large numbers of pistils, as for instance corn, where the silk represents the pistils, and every grain of corn on the cob has a silk or pistil, and should any one of these be injured that it could not perform its function, or should the pollen fail to come in contact with one or more of these, there will be a corresponding number of blanks on the cob. In the case of maize or corn the staminate flowers are the tassels at the top of the stalk. The pistilate flowers are the young ears. Should the tassels be removed, the ear remains barren. Breeders of corn take advantage of this and plant two varieties side by side, and at the proper time remove the stamens or tassels, that the pistils may be fertilized by the pollen from the other variety, thus combining certain characteristics of both parents.

While the complete flower consists of four sets of organs, only the stamens and pistils are essential to the production of seed. When both of these are present in the same flower, it is a perfect flower, and capable of reproduction. These are called hermaphrodite; they are self-fertile. But when the flowers contain the pistils alone, depending upon another flower that contains the stamens for fertilization, this is an imperfect flower, and is called a pistilate. This is of common occurrence with the strawberry. Many of the most productive varieties are true female or pistilate varieties. When such varieties are planted it is necessary to plant every alter-

nate, or every third row, a strongly staminate variety. Many planters select only such varieties as are perfect in themselves.

The same difficulty is experienced with the larger fruits. Many varieties are comparatively self-sterile, and when planted in large blocks give but little fruit. This will be treated further under the heading of Fertilization and Fructification.

PROPAGATION BY CUTTINGS.

Many fruits are multiplied by selecting healthy shoots of the previous year's growth, and taken when the tree is in a dormant condition, as when it is approaching this condition in the Fall of the year. Sometimes a portion of the previous season's growth is left with the cutting, making a short T at the bottom. When this is not to be had, or not preferred, the slip is cut smoothly just beneath a sound bud, as this seems the most favorable point for the emission of roots. Some plants root so readily that it makes little difference where cut, as the roots eminate at any point at the nodes or internodes. The preference for heel cutting depends upon the fact that near the base of the annual shoot there are always a greater number of dormant buds, but, being imperfectly developed, they are not noticeable to ordinary observation. They seem to favor the emission of rootlets. Cuttings may be made to grow if taken at any stage of their development, but require greater care, more uniform heat and moisture in the soil, if taken in a green or soft state. A great many of the flowering plants are taken at this stage and placed in sand in the cutting bed with bottom heat, where they root often in a few days, but cuttings of trees are usually taken in the dormant stage, because they can then be made to grow under ordinary conditions out of doors. If cut early in the Fall, after wood growth is perfected, they may be planted at once, or they may be placed in moist sand, sawdust, or wet moss in the cellar, and a very important step in their growth will begin at once. Whenever the temperature will admit, a quiet interchange of fluids will take place among the cells, new cells will be formed, until the cut surface will be covered with what is called callus. This is the first step toward growth, and this takes place more rapidly when the earth is warmer than the air; hence, the value of Fall planting, whether of trees or cuttings, if done before the earth has been chilled, and hence also the benefit of bottom heat in artificial propagation. If, on the other hand, the air is warm and the ground cold, the buds are often stimulated to burst forth before the rootlets can be formed. The expanding foliage offers an extended surface for evaporation, the contained juices in the cutting are soon exhausted, and, as no supply can be furnished, the plant soon wilts and dies. The cutting, like the seed, must first have the roots, then the blade. Cuttings should be

given as much time as possible for root formation, that when the leaves appear there will be an abundance of roots to supply the nourishment needed.

Root cuttings should be made in the Spring just before the bursting of the buds. The tendency to produce buds appears to be most active at that time. Gentle bottom heat greatly aids, but is not absolutely essential to the success of the operation. All trees and plants cannot be propagated by cuttings, as the woody tissue refuses to emit roots under almost any circumstances. Nobody thinks of propagating the peach or apricot by cuttings, and yet some of the stone fruit emit roots very freely, such as the Marianna plum, which is propagated by thousands for stock upon which to bud other weaker growing varieties, as they of themselves are very vigorous growers. The raspberry and blackberry do not grow well from wood cuttings, but are readily propagated from root cuttings.

The grape is multiplied by millions by cuttings. In earlier times this was done by planting long cuttings in the soil and left until two years old, but now they are produced from single eyes or buds. The propagation of the grape by single eye affords the most beautiful illustration of the subject of the individuality of buds. As already stated, the first effect of cell growth upon a cutting is the formation of a callus. This callus forms upon any cut surface, or even where the bark has been abraded. It is the first effort of nature to repair an injury by the reproduction of new parts; it is most generally found at the base of the cutting. The common method of setting a cutting is in a slanting direction in the ground, with but the uppermost eye above the ground. These slips are now made six to eight inches long, so as to have three or four eyes. Beyond doubt, a three or four-eyed cutting makes a stronger plant than the one-eyed. Such a cutting has a larger amount of organizable matter to be developed into the new parts to be produced, and certainly short cuttings, under neglect, will suffer more from drought. Yet, in practice it is frequently found that the short cuttings have better roots, which are near the surface, and even those plants, grown from single eyes, are better furnished than long cuttings produced upon the old plan, which placed the roots deep in the soil. Amongst the larger fruits very few are produced from cuttings, the quince, the oriental pears, and the Marianna plum.

Suckers.—One of the simplest methods of multiplying varieties is by means of suckers thrown up from the roots or around the crown of the tree. A century or more back many entire orchards were planted with suckers taken from ungrafted trees of good varieties. Some writers assert that the same variety cannot for a certainty be obtained from suckers, that there is a difference in the structure of the root and the stem, and that one cannot be substituted for the

other. Every gardener who has ever set cuttings knows that if a cutting is set with the upper end down, it will strike root from the small end as freely as if properly set. The cell circulation is entirely distinct from the circulation in the animal kingdom, which has the true arterial and venous currents of circulating fluids. The cell circulation in vegetable life can be conducted in either direction. Peel the bark from a tree in early June when circulation is active and the tree growing rapidly. Make a scratch across the cambium with the thumb nail, and watch the sap flow in both directions from the bruise, being discolored by exposure to the air, the brownish tint given to the sap is plainly seen as it rapidly flows in straight lines toward the base, or top. The roots are but the downward extension of the stem; under ordinary circumstances they have no need of buds, but if, needed, they may be and are developed. Buds do exist on the roots, especially upon those that are horizontal and near the surface, and suckers spring from them freely. If any one doubts this, let him visit my orchard, where we have removed several hundred trees that had been planted as fillers. Numbers of these roots had been left in the ground with the torn-off root extending above ground, and from these abundance of suckers have sprung up. There are many objections to this mode of multiplication, some claiming they do not have as good roots, that inherent disease of the parent tree will be transmitted, that they are not thrifty or long lived. None of these objections will hold good. When we see some of these old sucker trees that have withstood the elements for a century or more, great, large trees that have borne hundreds, perhaps thousands of bushels of apples, while, in the meantime, generation after generation of root grafted trees have been planted, lived their short life, borne a few crops, and died. One objection that has some truth, is, that suckers are apt to produce suckers. This we find in the wild plums, the Morello cherry, etc. This is all true, but as an offset to this is that the small fibrous roots which are supposed to bring about early fruitfulness abound in trees propagated from suckers, and that they are generally remarkable as prolific bearers, some of the varieties that have been long increased in this manner bear so early and abundantly as to prevent their ever forming large trees.

PROPAGATION FROM LAYERS.

This is the reverse to the last. Instead of the root emitting branches, the branch emits roots. Layering is frequently resorted to as a mode of propagation; it is very simple and easily performed. A low down shoot is bent down and buried in the middle, and the buried portion strikes root. To make it do so more readily make an incision immediately under a bud, which causes it to callus and

throw out roots, and these newly formed roots pass freely and at once into the soil without the resistance of the thick bark. Sometimes the branch is cut partly off to intercept the downward passage of the fluids and induce them to form roots. At other times a wire ligature or the removal of a small ring of bark is resorted to for the same purpose. Burying the part several inches beneath the surface is necessary to keep it in the moist earth, and mulching is an excellent auxiliary.

The most favorable state of a plant for layering is when the bark is somewhat soft and not too ripe. The pear, the apple, and the quince, if layered in early Spring, or the grape in Summer, will be usually well rooted by Fall. A moist season is the most favorable to the rooting of layers, by preserving a softer bark.

PROPAGATION BY BUDDING.

This operation is performed during the growing season, and usually on young trees, from one to five years old, with a smooth, soft bark, although older trees may be budded on the limbs. For the larger trees a stout, heavy bud of the past season's growth, or a terminal of a limb is taken.

Budding consists in separating a bud, with a portion of bark attached, from a shoot of the current season's growth of one tree, and inserting it under the bark of another. When this bud begins to grow, all the part of the stock above it is cut away, the bud grows on, and eventually forms a tree of the same variety as the tree from which it is taken. Buds may be inserted in June and make considerable growth the same season. Millions of peaches are budded at this season. Until Fall they have made a growth of from six inches to a couple of feet, when they are sold as June budded trees, thus placing them on the market one year sooner than by the regular system. The ordinary season for budding in the North is August and September, depending on the condition of growth. Those making their growth early in the season are budded early, and those growing until Autumn are budded late. Thus the season extends over a period of two months. The shoots containing the buds should be cut when so mature as to be rather firm and hard in texture; they are usually in the best condition after the terminal bud has formed. To prevent withering, the leaves must be cut off, leaving only the stem remaining to serve as a handle to the buds while inserting them. After being divested of their leaves they can be kept a week or more in a cool, moist place. If buds are wanted earlier than they ordinarily mature, maturity can be hastened very much by pinching the tips of the shoots. In ten or twelve days after the pinching of a very soft shoot, its buds are fit for working. The stock must be in proper condition. The bark must raise freely from the stocks to be budded. This only happens when

the stocks are in a thrifty and growing state. Trees that make their growth early in the season must be watched and budded before they cease to grow. Trees that grow late must not be budded early, or the formation of new wood will surround and cover the buds.

With the stocks, buds and implements in condition, the operation is performed as follows:

The shoot or bud is taken in one hand, and the budding knife in the other; the lower part of the edge of the knife is placed on the shoot, half an inch above the bud to be removed; the thumb of the

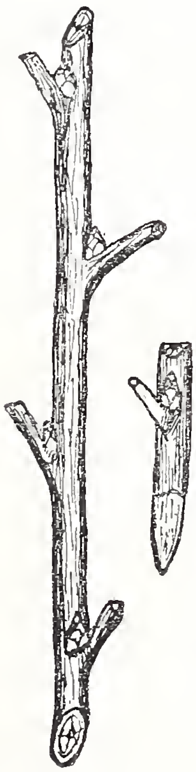


Fig. 1. Bud stick, with bud prepared for insertion.

Fig. 2. Stock ready for insertion.

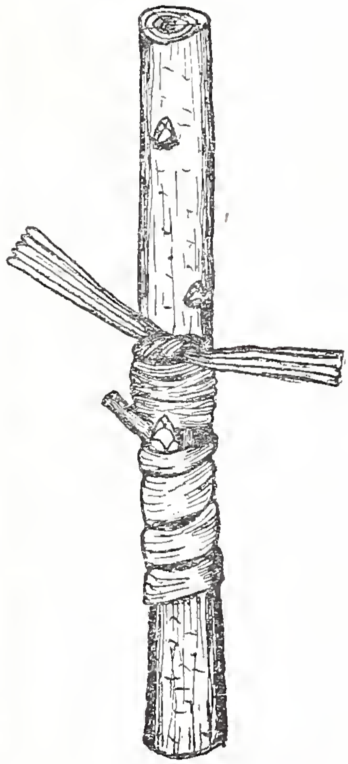


Fig. 3. Bud inserted and secured.

knife hand rests on the shoot below the bud. A drawing cut is then made parallel with the shoot, removing the bud and bark, to which it is attached, half an inch above and three-fourths of an inch below it. This is the usual length, but it may, in many cases, be shorter. The cut is made just deep enough to be below the bark. A small portion of the wood is always taken off with it. It should be allowed to remain if it adheres firmly, but, if it parts easily, it may be removed. (Refer to cut.) A smooth place is then chosen on the stock, clear of branches, where two incisions are made to the depth of the bark, one across the shoot, the other

parallel with the shoot, so as to form a T, as in Fig. 2. The bark on the two edges of the perpendicular cut is raised, and the bud is inserted between them and shoved down; the upper end of the bark attached to the bud is cut off square, and a piece of bass string or a woolen yarn is wound tightly around, commencing at the bottom, and covering every part of the incision, leaving the bud itself, and the leaf stock uncovered, the string is fastened above the horizontal cut and the work is done. (Fig. 3.) The success of the operation depends to a great extent upon smooth cuts, and exact fit of the bud to the incision made for it. Secure close tying to exclude the air and rain water. The work must be quickly done; it should not occupy more than a minute, as the parts dare not be left exposed. A good budder will put in from one to two hundred per hour, having a person to tie. The chief difficulty with beginners is the proper removal of the bud. Should the bud be large and shouldered, as happens in the pear and plum, it sometimes when the piece of wood is removed a cavity remains, which does not come in contact with the wood on which the bud is placed, and, therefore, although the bark unites well, the bud fails to grow. A little practice will enable the budder to overcome this and other difficulties.

UNTYING THE BUD.

In ten days or two weeks after the buds have been inserted they should be examined, and such as have failed to grow may be rebudded if the bark on the stock still peels readily. With cherries and some other stock it may be necessary to loosen the string and retie it, as the stock grows so rapidly the string becomes imbedded in the bark before the bud is fully united, or is fit to be untied. This very seldom happens. When the union is complete all the buds should be untied or the string cut with a sharp knife, permitting the bark to expand. This can generally be done in three or four weeks from the time the bud is inserted. If left too long, the string becomes so deeply imbedded as to seriously interfere with the circulation. Never leave these bands on over Winter, as water lodges around the bud and freezing likewise injures the bud. The after-treatment of buds depends whether the budding is done on larger trees, to rehead, or whether it is on one year seedlings, or nursery stock. If the latter, early in the Spring, about the time the leaves begin to appear, the stock should be headed down to within two or three inches of the bud, and all buds starting into growth above, as below the bud, should be rubbed off, and this must be continued through the season, thus throwing all the growth into the bud, which will make rapid growth. In August the portion of the stock left above the bud should be removed with a smooth sloping cut, just above the union of the bud and the stock. The new growth will generally cover this before growth ceases in the Fall. Side shoots, when they

appear, must be checked, that they do not detract too much from the leader, but should not be removed entirely, as they assist in giving size and strength to the stem. Pears and apples do not throw out so many side shoots the first year, but the peach sends out shoots nearly two-thirds the length of the stem, and it is a common practice by those lacking experience to keep them cut off. This is a great mistake. and has a tendency to give long, spindly trees, whereas, if left with only moderate pinching in, they give healthy, stout, well-proportioned trees. This brings them to the end of the second year from the seed, or one year from the bud, at which age all peach trees should be set out. The after-treatment will be given under the head of pruning.

If the budding has been done on trees already transplanted, to change varieties, then the pinching back should be done to the leader, so as to throw more growth into the side branches to give a flatter and more spreading head, and at the same time bring it into earlier bearing by developing fruit spurs. This method is seldom resorted to for reheading trees. Grafting is a better system, but if grafts fail to grow, then a strong bud may be inserted in June, thus gaining time.

PROPAGATION BY GRAFTING.

Propagation by grafting differs mainly from increasing by cuttings, by inserting the cutting into the growing stock of another tree, instead of directly into the soil. The stock thus supplies the sap. as the soil does in the case of the cutting; and the graft, instead of making roots of its own, extends its forming wood downward, at the inner surface of the bark, into the stock itself; hence, the two chief requisites for success: First, that the graft be so set in the stock that the sap may flow upward without interruption, and the second, that the wood forming may extend downward uninterruptedly through the inner bark. To effect this, it is needful that the operation be performed with a sharp knife, that the vessels and pores be cut smoothly and evenly, and the two parts be brought into immediate and even contact; secondly, that the operation be so contrived that a considerable pressure may be permanently maintained, to keep all the cut surfaces close together; thirdly, that the line of division between the inner bark of the scion should correspond, exactly with the inner bark of the stock, for, if they do not correspond, union cannot take place, as the current of circulating sap is broken, and the graft cannot grow; and, fourthly, that the wounded parts made by the operation be so covered by wax as to exclude the air, and retain a due quantity of moisture in the graft, also to exclude rain until by growth the union is complete.

To attain the first requires a keen, thin-bladed knife to cut the faces of the scion, and another knife for other purposes. The second requisite requires the jaws of the stock in cleft grafting press with sufficient force to hold the scion firmly. In whip grafting, the tongue and slit should be pushed firmly together and tightly bound.

The third requisite is attained by close examination. The fourth is attained by grafting wax, or by the application of grafting clay.

One species is frequently grafted upon another, by which certain modifications are wrought upon both size and fruitfulness of the tree and the quality of the fruits. Thus, we can graft the peach and apricot upon the plum, or vice versa. The pear upon the quince, strong growing varieties on weaker ones, and vice versa.

But experience has established the fact that there must be between the stock and graft a close alliance. We cannot graft an apple on a peach, nor a cherry on a pear; but the pear, apple, quince, thorn-apple and mountain ash, a naturally allied group, may, with more or less success, be worked upon one another. All such assertions we frequently read about, of grafting the peach upon the willow, to produce fruit without stones can be set down as so much nonsense.

There are a great many methods of grafting, but the two I shall describe are those almost exclusively used.

Stocks are used of all ages, from one-year-old seedlings to old trees; but whatever their age, they should be sound and healthy. Scions are generally of the previous year's growth; they are preferably cut in the Autumn after the fall of the leaf, or in the Winter, and preserved in earth or moist sawdust or moss until wanted for use, but, should more be needed, they should and can be cut and placed immediately on the stock with success, though more care must be used, as the bark separates itself easily in dressing the scion. They should be selected from healthy, vigorous trees, the wood should be firm and well-ripened from the upper branches of the tree. The implements used are the grafting knife, saw and chisel.

Wax.—Various combinations of the materials used in the preparation of grafting wax have been recommended. It should be sufficiently pliant, yet firm enough to withstand the heat to which it will be exposed during the summer. It should be that happy medium, neither too hard or too soft. This varies according to its proposed use, whether for outdoors or in the house, in cold weather.

A favorite wax for indoor use by nurserymen is as follows:

$$\left.\begin{array}{l}\text{Rosin, six parts,}\\ \text{Bees' wax, one part,}\\ \text{Tallow, one part.}\end{array}\right\}\quad\text{Melted together.}$$

This is to be used warm when grafting in the house.

For outdoor work the following is very good:

Rosin, four parts,
Bees' wax, two parts,
Linseed oil, one and one-half parts.

This should be melted together, and as it cools, work well, drawing out like taffy. This can be applied by hand or when melted pour upon thin muslin, calico, or strong paper, spread very thin, then cut into convenient strips for wrapping around the stock.

An excellent wax, and the one I use exclusively, is composed of the following:

Three pounds rosin,
Three pounds bees' wax,
Two pounds tallow.

Melt together and work until perfectly smooth. This can be applied readily by hand, keeping the hands greased with tallow to prevent it sticking. This wax does not crack by cold and does not run by summer heat.

The method of grafting depends much upon the size of the tree. Where the stock is small that corresponding thickness of scion can

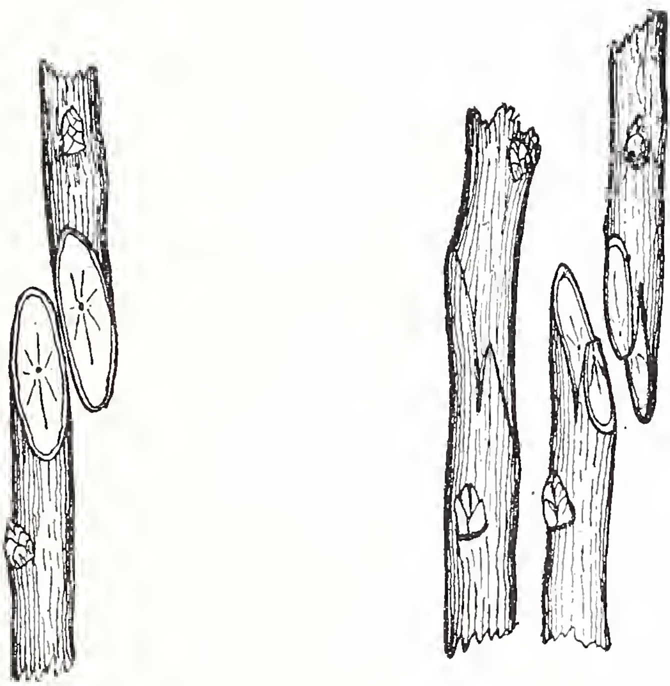


Fig. 4. A. Splice graft. B. Whip or tongue graft.

be obtained, the simplest method is the splice graft. (See A in cut.) The two are cut with a slope, each made at the same angle that will coincide with the other when applied together.

Whip grafting is a modification of the above. Each part is cut as in splice grafting, but each is split with a thin-bladed knife. (See B

in cut.) The object is to give a firmer union of the parts, and also to give a larger surface for the effusion of the new cell tissue. After the parts are put together they must be bound tightly with waxed muslin in narrow strips, or with string, then waxed to keep out air and water.

Cleft Grafting.—This is the method generally adopted out of doors and in all cases where the stock is much larger than the scion. The stock is split after having been cut off at the point where the grafting is to be done. The knife should be sharp, and the bark should be cut through first to avoid its being torn and that the sides of the cleft will be smooth. A wedge is inserted to keep the cleft open for the insertion of the scion, which is cut on each side like a fine wedge, with the outer side slightly thicker. The object is to have the pres-

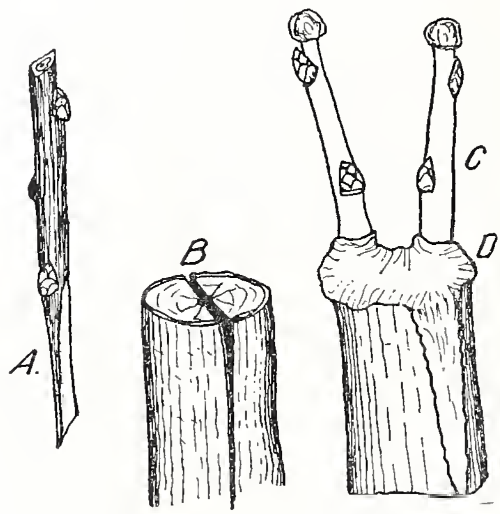


Fig. 5. Cleft grafting.

A. Shows scion trimmed.
B. Shows stock split ready for inserting the scion.
C. Shows scion inserted; D. Sealed shut with wax.

sure of the cleft greater on the outer edge of the scion. It is well to have a bud on the strip of bark between the two cuts used in forming the graft. This should be near the top of the cleft. One or two grafts may be inserted in the cleft. My rule is, if the stock is one inch or more thick in diameter, to insert two grafts, leave both grow the first season, to heal the wound, closing the cleft, then remove one, preferably leaving the one with its back facing the way of the prevailing winds, as that being braced, can withstand a gale without being split off.

RECAPITULATION.

Use sharp instruments to make smooth, clean cuts. Have the inner bark of the scion and stock in perfect contact. Have the whole cut surface and every part of the split covered with the

grafting wax to exclude air and water. Cut the scion close to a bud at the top, and have a bud at the shoulder, or point of union with the stock.

THE FRUIT BUD.

Since the principal object of pruning is to secure better fruit, it is necessary that the owner become familiar with principles and capable of distinguishing a fruit bud from a leaf bud, and knowing on

Fig. 6. Apple twig. Fig. 7. Same before leaves fell.

what part of the tree they are produced and how to produce them, as they can be produced at the will of the horticulturist. Buds are interchangeable—that is, the bud that, if left to nature would give

a leaf bud may be converted into a flower bud, and a flower bud may as readily be made to start out a new shoot. A tree that is making wood rapidly, throwing all its energies into tree formation, is very slow coming into bearing, producing leaf buds only. On the other hand, a tree making slow growth from lack of sufficient food, or one in any way injured, or from disease, anything that tends to curtail the usefulness, size, or beauty, as well as the permanence of onr trees, anything that threatens the vitality of the tree, tends to make it fruitful; it calls into activity the instinctive effort to perpetuate the species by the production of seed, that may be separated from the parent, and establish a separate and independent existence, to take the place of the life of that which is threatened.

The two kinds of buds, as illustrated in Fig. 6, would seem antagonistic, but we must bear in mind the two great acts in vegetable life—that of wood growth by extension, and the wonderful evolution of this growth into flowers and fruit.

The first, the leaf buds, we notice are on the newer growth, the terminal branches. They are essential to the production of timber, to the building up of the tree, and should be encouraged to do their work undisturbed, and if they fail from any cause they must be made to perform this function by the various means known to the horticulturist, such as pruning, fertilizing, etc., up to a certain point, until they have built up a substantial frame work by which their fruit can be supported. The latter is, however, the ultimate desideratum of the fruit grower, and he anxiously looks forward to the time when it has built up its complicated structure of limbs and branches, with some consequent obstruction to the flow of sap, depending upon the hardening of the wood tissues and the tortuous course of its circulation. It then appears to have reached maturity, or its fruit-bearing condition. It then ceases to make such free wood growth, and prepares to set buds which produce bloom. In some varieties this time is more extended than the impatience of the fruit grower desires, and he frequently resorts to such means as experience has taught will bring about early development of fruit buds. He resorts to pinching, or summer pruning, which interferes with growth by extension and aims at the vitality of the tree; interrupting the circulation by ringing, by ligatures, by hacking, making incisions below the buds, twisting, bending the limbs down, hanging weights on the tree—anything that tends to check growth by extension. In referring to Fig. 6, the apple twig is divided at the point "a" into two parts. The part from a to b grew the last season, and the portion below grew two years ago. The buds upon the two parts are widely different, and this difference challenges investigation. That we may have a better understanding of the cut, it will be necessary to look at last Summer's growth, as shown in **Fig. 7**,

which has just completed its growth; there is only one leaf at each place. In every axil (or angle which the leaf makes when it joins the shoot) is a bud. The leaf stands first, and as the season advances, the bud forms. When the leaves fall in Autumn, the bud remains as seen in Fig. 6. Every bud seen upon a twig in the Winter marks the place where a leaf existed when the shoot was growing.

The two year's old section, that below a, in Fig. 7, shows an entirely different arrangement. Here the leaves are in pairs, and often several leaves together (c.c.c.c.), and these places along the stem where buds exist, without leaves (d.d.d.d.). A year ago this portion looked like the present shoot from a to b—that is, the leaves stood singly with a bud in the axil of each. It will be noticed some of the buds are longer than others, and where the leaves exist the buds are the longest, and it is owing to this fact that they have increased in length, for, if through accident the leaf is broken off, the bud ceases to grow. These longer buds are like the shoot a, b, and they are the same age, but shorter; but, nevertheless, as much a branch as a, b. The difference in length is owing to the fact that the branch a, b grew from a terminal bud, while the short ones grew from lateral buds. The tendency of the sap is to flow more strongly toward the end of the shoot or terminal buds. The dormant buds (d.d.d.d.) remain the same size, as they have no leaves as feeders to develop them. The only way for a mature bud to grow is by making new leaves for themselves, for a leaf will never grow below a bud again; it must be produced from the bud itself. The twig has, therefore, buds of two ages; those on the tips of all branches (c.c.c.c.b.), and in the axil of every leaf are one season old. It is only the buds on the end of the shoots that are not axillary. As long as they remain dormant, they are classed buds. When they begin to grow and put forth leaves, they give rise to a branch, which, in its turn, bears buds.

Let us consider why some of the buds remain dormant and others give rise to branches. The strongest branches or shoots are the terminal ones (a.b.), the next in strength are the uppermost lateral ones, and the weakest shoots are at the base of the twig. The dormant buds are generally on the under side of the twig, for the twig grew in a horizontal position. This suggests that those buds grew which had the best chance, the most room and sunlight. There were too many buds for the space, and it became a matter of the "survival of the fittest." Those having the best opportunities grew the strongest, making the largest growth. This struggle began a year ago, when the buds upon the shoot below (a) were forming in the axils of the leaves, for the buds near the tip of the shoot grew larger and stronger than those nearer its base. The growth of one year is determined largely upon the conditions under which the buds were formed the previous year.

LEAF BUDS AND FRUIT BUDS.

We have shown in Fig. 6 that the one-year-old shoots are wood branches, or those bearing only leaf buds, and the two-year's old are the one, which, when the tree is of proper age, produce fruit buds. This is not always true; we sometimes find trees on which the terminal bud on young shoots of last season's growth are fruit buds. We also frequently find long, slender, terminal branches, which, to all appearances, are but one year old, on which the terminal and several of the lateral buds are fruit buds, but, upon closer scrutiny, we note that these buds are mounted upon short lateral

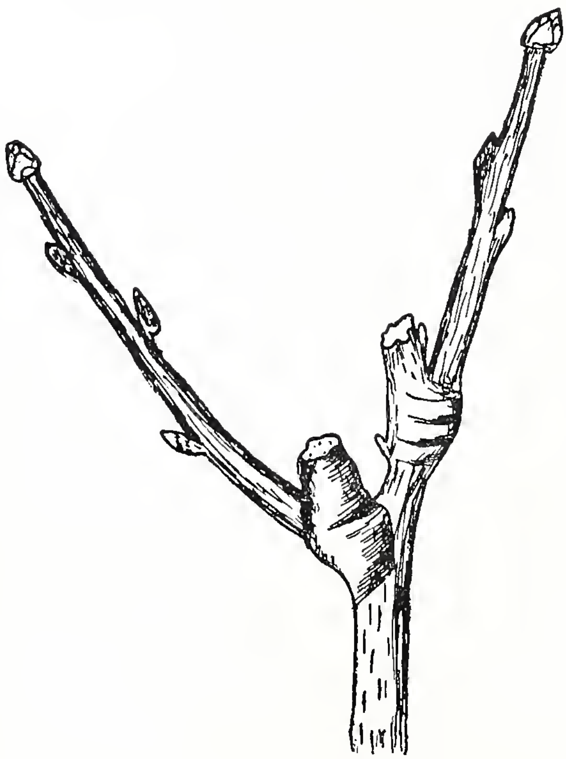


Fig. 8. Swelling resulting from fruit bearing.

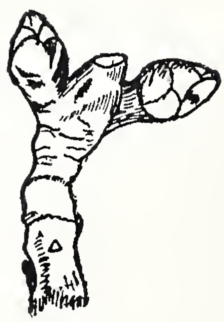


Fig. 9. Pear fruit buds resulting from the removal of fruit.

branches. The terminal bud also has a short section between the bud and the branch proper. It will also be seen that above the line of demarkation between this twig and the two-year-old, there are dormant buds. The twig above must be more than one year old. If these small branches bearing the buds are one year old, then the shoot bearing them must be two years old. The ring marking the termination of the year before is, therefore, just below the short section which bears the terminal bud. A twig, generally speaking, is one year older than its oldest branch.

Fruit branches are those bearing fruit buds exclusively. They are presented to us under different forms and circumstances, all of which it is of the highest importance to understand.

In the apple, pear, and other kernel fruits, the ordinary form of the fruit branch is that generally called the fruit spur, as shown in Figs. 8 and 9.

It appears first as a prominent bud on wood at least two years old; for the first year or two it often produces but a rosette of leaves, as shown in Fig. 10, and continues to increase in length until it fruits.

After it has produced fruit, it generally branches, and, if properly managed, will bear fruit for many years. Apple and pear trees of bearing age, and in fruitful condition, will be found covered with these spurs on all parts of the head, except the young shoots. In addition to the fruit spurs, there are on the kernel fruits slender fruit branches about as large as a goose quill, and from six to eight

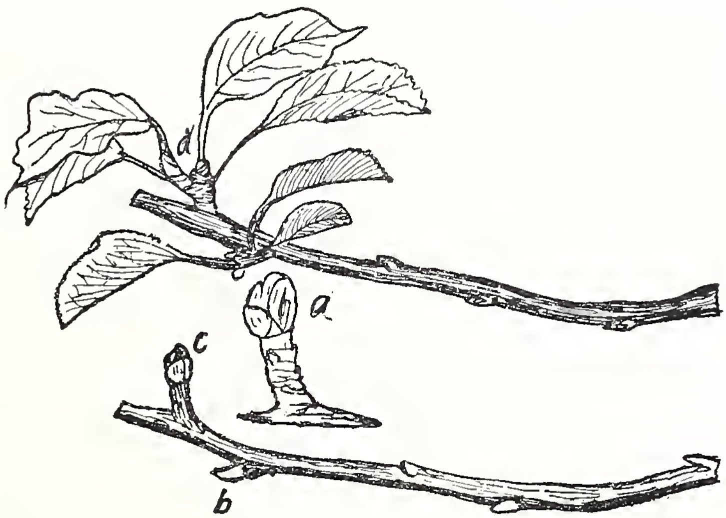


Fig. 10. Fruit branches A and C are fruit spurs that will produce flowers next year; B is a pointed bud that will have a rosette of leaves next year; D shows a rosette of leaves; the bud will produce flowers next year.

inches long. The buds are long, narrow and prominent, and the first year or two after their appearance, produce but rosettes of leaves, yielding fruit generally about the third year. On trees well furnished with fruit spurs, these slender branches are of little account, but are useful on young trees not fully in a bearing condition. They are generally produced on the slender shoots or wood buds only; but, owing to their unfavorable position and feeble structure, they receive only a small portion of the ascending sap, and the consequence is they become stunted and transformed into fruit branches. In pruning young branches, young shoots are frequently bent over and fastened in a crooked position to transform them into fruit branches of this kind.

The fruit branches of the peach and apricot are productions of one season's growth; the fruit buds from one season and the blossoms

the next, but these will be treated of in their proper place. In a practical point of view, buds are certainly the most important organs of trees, because it is through them that we are enabled to completely control their forms and their productiveness.

Whoever, therefore, wishes to become a skillful and successful tree culturist, must not fail to make himself familiar with all their forms, modifications, modes of development, and the purposes they are adapted to fulfill in the formation of the tree and its products. The immediate causes of the productions of buds on the growing shoots of trees, and the sources from which they spring or in which they originate, are alike thus far mysterious, notwithstanding they have been the subject of a vast deal of research and speculation among the botanists and vegetable physiologists. We are able, however, to trace clearly and satisfactorily the objects they are intended to fulfill in the development of the tree, their connection with, and dependency upon other parts, and the circumstances under which they can be made to accomplish specific purposes.

THE NAMES OF BUDS AND THE CHARACTERS.

All buds are either, (1) Terminal, as when on the point of a shoot; (2) Axillary, as when situated in the angle made by the projection of a leaf from the shoot or branch; (3) Adventitious or Accidental when originating accidentally, as it were, without any regularity, on the older parts of trees, and not in the axil of a leaf. They are produced by the breaking or cutting away of a branch, or by a wound or incision made in the bark. In the management of trained trees, special means are taken to produce those buds on spaces on the trunk, that we desire to fill up. We sometimes see such buds on the stumps of old trees. The terminal and axillary buds produced on young shoots seem to have a different origin from accidental buds; the former are connected with the pith of the shoot, as we may see by dissecting them. On cutting into a young shoot below a bud, we find a cylinder of pith entering into the bud from the pith of the shoot, but we do not find this connection existing in the case of the adventitious buds.

Practically considered, buds are classified as follows:

1, Lateral.—Those on the sides or circumference of shoots being the axillary buds.

2, Terminal.—Those on the points of shoots.

3, Superior.—Those on the upper side of horizontal branches.

4, Inferior.—Those on the lower side of horizontal branches.

5, Stipular.—The small, barely visible buds found at the base of ordinary buds.

6, Dormant or Latent.—These are scarcely apparent, generally towards the base of the branches. They may remain dormant for

several years, and then, in some species, be excited into growth by pruning close to them.

7, Leaf Buds.—Produce either leaves or branches; they differ in form from fruit buds, in being, in most cases, longer and more pointed in the same species.

These are designated as:

Single, when only one is produced at the same point.

Double, when two are together.

Triple, when three leaves are together.

These double and triple buds are most peculiar to the stone fruits, especially the peach and apricot.

The size, form and prominence of leaf buds vary very much in different varieties of the same species, and these peculiarities are of value in identifying and describing sorts. Thus, the buds of one

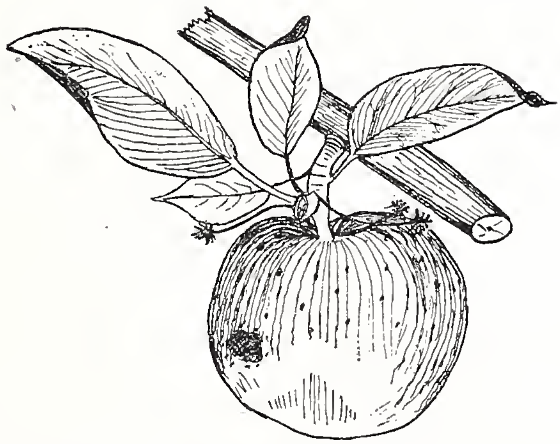


Fig. 11. Fruit spur bearing an apple, the remains of the flowers that failed to set, and the bud which is to continue the growth of the spur.

variety will be long, pointed and compressed, or lying close to the shoot. Others will be large, oval and prominent, or standing boldly out from the stock. Others will be small, full and round. If the buds on the ends of the branchlets produce flowers, the twig cannot increase in length; for an apple is invariably borne on the end of the branch or spur, and, therefore, no terminal bud can form there. If growth takes place on the twig next year it must rise from one of the lower leaf buds. When fruits or flowers are borne on the end of a spur, the direction of the subsequent growth must necessarily be changed. Fig. 11 is a bearing spur of the apple, with a mature fruit, and plainly shows a lateral bud forming for the continuance of the spur next year. This side bud is generally a leaf bud, for it must be the means of continuing the growth, and it is not likely to get nourishment enough (as the apple is the chief concern) to develop

into a fruit bud. There is, therefore, an alteration of fruit-bearing buds and non-fruit bearing buds on the spur of the apple tree and most other fruit trees.

In the early stage of their formation and growth all buds are leaf buds. Thus, on a young shoot of a plum or cherry, for example, of one season's growth, the buds are all leaf buds. The next spring a part of these produce new shoots, and others are transformed into fruit buds that will bear fruit the following season. The transformation is accomplished during the second year of their existence, and it usually happens that they are the smallest and least fully developed that are so transformed; the more vigorous pushing into branches. On the peach, the apricot, etc., on which the fruit buds are produced in one year, the change from a leaf bud to a fruit bud occurs towards the latter part of the season.

To still further explain the formation of fruit buds on the apple, and to repeat some of the foregoing observations, let us trace the history of given branches.

One of these twigs, Fig. 12 and 13, was taken from a strong, young tree, which bore its first good crop of apples last year. This twig is plainly of two years' growth, as indicated by the "ring" between the old and new wood at B. The main stem from the base to B grew in 1904, and the part from B to tip grew in 1905.

The buds on these two parts look very different. Let us see what this difference means. We will now picture in our mind how this shoot from B to C looked last Summer while it was growing. The shoot bore leaves, one below each bud; or, in other words, one bud developed above each leaf. These buds did not put out leaves; they grew to their present size, then stopped.

What will these buds of the tip shoot do in 1906? We can answer this question by going back one year and seeing what the buds on the lower part of the shoot did in 1905, as we did in Fig. 12. Upon that part below B, the buds have increased in size. Therefore, they must have grown last year. There were no leaves below these buds last year, but a cluster of leaves came out of each bud last Spring. As the leaves expanded and grew, the little buds grew on; that is, each bud grew into a tiny branch, and when Fall came, each one of these small branches had a bud on its end to continue the growth in the year to come.

But the strangest part of this twig is, that the branches are of different sizes, three of them, L, J, K, have grown several inches, and the very bottom bud (a) never grew at all, but remained perfectly dormant during the entire year 1905. It will be noticed that the dormant bud, and the smallest branches are on the lower part of the shoot, and the three strong branches are at the tip of the last year's growth.

If we now picture the twig as it looked in 1904, we will see that it consisted of a single shoot, terminating at B. It had a large terminal bud (like those of C, L, J, K), and this bud pushed on into a branch in 1905, and three other buds near the tip did the same.

Fig. 12. A two-year-old shoot from a young apple tree, half size.

Fig. 13. A three-year-old shoot from a young apple tree, half size.

Some of these branches grew to be larger than others, because they had more sunlight and more room on this outward and upper end. In 1906, this shoot, if it had been spared, each of the four largest shoots would have done the same thing, as the parent twig

did in 1905; each would have pushed on from its end, and other strong branches would have started from the strong side buds near the tips, the very lowest buds would, no doubt, have remained perfectly dormant for want of opportunity, and the intermediate buds would have made short branches like D, E, F, G, H. The tree always tries to grow onward from its tips, and these shoots eventually become strong branches, unless some of them die in the struggle for existence. What becomes of the little branches lower down? Fig. 13 illustrates this. We note at a glance it is entirely different from that of Fig. 12. It seems also to be two years old, one year's growth extending from A to G, and the last year's growth extending from G to H; but upon looking closer, you will note that the short branchlets at C, D, E, F are very different from those in Fig. 12. They seem to be broken off. The broken ends are where the apples were borne in 1905. The branchlets that bare them, therefore, must have grown in 1904, and the main brauch, from A to G must have grown in 1903. It is plain, from the looks of the buds, that the shoot from F to H grew during the year 1905. Starting from the base, then, we have the main twig growing is 1903; the small side branches growing in 1904; these little branches bearing apples, 1905, and the terminal shoot also growing in 1905. Why was there no terminal shoot growing in 1904? Simply because the tip developed a fruit bud at F, and therefore could not send out a branch. For there are two kinds of buds, the small, pointed leaf bud, and the thick, blunt fruit bud. If the branchlets C, D, E, F, are two years old, the dormant buds, A and B, are also two years old. For two long years have these little buds been waiting for an opportunity to develop, but they have waited in vain.

We have now found that these little side branches may become fruit branches or fruit spurs, while the larger, stronger branches have been producing stems and leaves. But will these fruit spurs bear again in 1906? Not likely, as we ordinarly find orchards. The bearing of fruit is exhaustive work, and a very heavy crop has reduced the vitality to such an extent there is not sufficient remaining to make fruit buds for the next year; but they must perpetuate themselves, so they have sent out small side buds, which will bear a cluster of leaves and grow another little spur in 1906 that will bear fruit in 1907. The side buds are plainly seen on the spurs C, D, E, and the spur F has thrown out a bud at G. This is the reason why so many trees bear fruit only on alternative years, resting to recuperate on the off year.

OFF YEARS.

Is this essential? Not at all; and if a tree is not permitted to become too low in vitality by overproduction, there will be no off

year, as this is contrary to nature's laws. Reproduction is its chief function, and it is only through lack of proper management that this occurs.

How shall we evade it? How shall we obtain and maintain annual production? First, by properly pruning and thinning out the top that there shall not be an over amount of wood; by forming an open head, permitting plenty of air and sunshine to penetrate to every part of the top; by having fruit spurs well distributed on every part of the tree except the last season's growth; by keeping the tree in full supply of clean, healthy foliage, that sufficient plant food may be elaborated and distributed to every part of the tree; by never allowing the tree to overbear and thus become devitalized; by thinning the fruit until the tree has assumed the regular bearing habit; by applying sufficient fertilizer that it may never suffer for lack of proper and available food for wood growth and fruit; by keeping an abundance of moisture in the soil, either by culture or mulching; by spraying with both insecticides and fungicides. By close observation of these rules there will be no failure, no off year, but an annual production of fine, smooth, perfect, high-colored fruit of the best quality will be the reward.

LEAVES.

Their Structure and Functions.—The leaves of all hardy cultivated fruits in our climate are deciduous, that is, they separate from the stalk and fall in the Autumn and are succeeded by new growth in the Spring. The function of the leaves is one of vital importance to the health and life of the tree during the growing season, and deserves the most attentive consideration. A leaf as shown in Fig. 14 is composed of two principal parts, the stalk or petiole (A), which connects it with the tree or branch upon which it is borne, and the blade or that part which spread out (B, C, D, E.) The part attached to the stalk is called the base (C), and the remote, pointed part, the apex (D). The length of the leaf is from C to D, and the width, a line cut at right angles from E to B.

The leaf stalk and its branches, forming the veins of the blade, are similar to the woody parts of the tree or branch that bears it, inside of which is a pith similar to the pith of the tree; the leaf is thus connected with the pith and wood of the shoot, and, consequently, with the ascending sap, as may readily be seen by making a vertical cut through the leaf stalk and shoot. The space between the veins of the leaf are filled up with a cellular substance similar to the pith, called parenchyma, and the whole is covered with a thin skin, epidermis. The cellular substance of the leaf is connected with the inner bark, and, consequently, with the descending sap, or cambium, that forms the new layers of wood. Both surfaces of the

leaf are furnished with small pores, through which exhalation and absorption are carried on. These are most abundant on the under surface.

This property of the leaves to give out air and moisture through the pores on their surface has likened them to the lungs of animals; thus, we frequently say the leaves are the lungs of the tree or plant. This comparison is, to some extent, correct; for we know that, without leaves, or organs performing their offices, trees do not grow. In proportion to the natural healthy action of the leaves, do we find the vigor and growth of the tree. Leaves have the power, more or less, to absorb moisture. Plants may be wilted by the heat and evaporation during the day, and the dews of a single night will revive them.

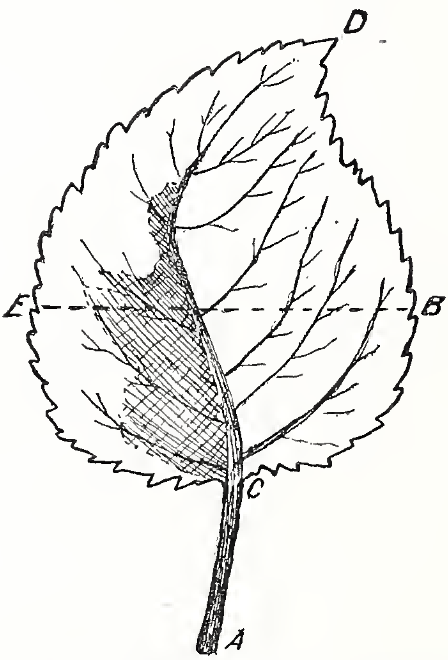


Fig. 14. A. the leaf stock, B. C. D. E. the blade, C. the base, D. the point, line E. B. the width.

If a plant is badly wilted, it can be revived by sprinkling the leaves and protecting them from sun and hot air. That plants exhale moisture and gasses cannot be doubted. This is what causes plants to wilt during the hot Summer days. Plants that are transplanted with their foliage on almost always wilt, and if the ground lacks sufficient moisture they will die unless well watered. The safest way is to clip the largest portion of the foliage and plant toward evening, when a plant recovers to a large extent and soon sends out new roots. Covering the plant immediately after transplanting likewise prevents wilting, by preventing the rapid evaporation through the leaves. The same principle is carried out in freshly transplanted

trees. In digging, a large proportion of the roots are removed. If the top is left entire, the tree is unbalanced, there being too large a proportion of top and too many leaves, with their countless numbers of pores, which evaporate the moisture faster than the mutilated roots can replenish it. The result is that the tree cannot survive. But when the top is severely pruned back, thus reducing the number of leaves, consequently reducing evaporation, trees thus treated, with trunks shaded and ground mulched, there will be scarcely one per cent. loss. The juices previously stored up in the cells of the young tree will be sufficient, with the addition of the root supply, to tide it over until the roots are again re-established. The same difficulty is experienced in budding, if the entire leaf is left attached to the bud. The evaporation will be so great as to kill the bud; hence, we remove the leaf and part of the stalk, leaving just sufficient to be used for a handle in inserting the bud.

A tree can neither mature its wood or fruit without the full and healthy exercise of the leaves. We frequently see a limb defoliated by tent caterpillars, when the growth of the limb and branches is suspended until new leaves are re-established. Several years ago I sprayed a number of peach trees with a weak solution of sulphate of copper. Although only four ounces of the copper was used to fifty gallons of water, yet the leaves of the peach tree were so delicate that the trees lost their entire crop of leaves. Trees on which the peaches were ripening, the fruit suffered but little, as the juices stored in the trees brought the fruit to full maturity; but on those trees on which the fruit was not fully matured, it ceased growing. Many of them wilted and dropped, the rest remained undersized and lacked both color and flavor. These facts and many others that might be cited, show the close connection between the leaves and the other organs of trees, and the influence they have on their growth and productiveness. It is a well-known fact that even the roots of a tree cannot long grow and maintain a healthy condition without foliage on the tree. That they can grow for a limited time is shown in the newly planted tree. I have frequently seen new roots a few inches long that had grown on trees that were heeled in the ground after the tree became dormant, and they were removed before the buds had made any start in the Spring; but, in case from any cause the buds failed to grow and send out new leaves, this growth would soon be suspended and remain quiescent until the leaves made their appearance, and if they failed to do so the roots also died. The fact of the absorption and exhalation by the leaves of certain fluids had, to a very considerable extent, established the theory that the sap of trees is taken up from the roots, through the cells or sap vessels of the wood of the trunk and branches in a crude state, and passes into the leaves; that in their tissue, spread out

under the sun's rays, it receives certain modifications. Carbonic acid, which has been taken up in a state of solution from the soil, and by the leaves from the atmosphere, is decomposed. Oxygen is given off into the air, carbon becomes fixed, and thus the component parts of the tree, the material of the cells, starch, sugar, gum, etc., are formed. After passing through this purifying or concentrating process the sap acquires a more solid existence and is called cambium; so prepared, it returns downward through the vessels of the leaf to the base of the leaf stock, and then between the wood and bark of the stem, forming new layers on its passage. Such is, at present, the most popular theory of the functions of the leaves, and the ascent, assimilation and descent of the sap. Some distinguished writers on the subject reject this theory, alleging that "there is no such thing as crude sap; that as soon as it enters the roots it becomes assimilated and fit for the production of new cells, and that it passes upward, forming new wood cells by a chemical process." Observation, however, has clearly established that, in the leaves of healthy trees, chemical processes, depending on light and heat and absolutely essential to the well-being of the tree, are continually going on; for trees shut out from the light always make a feeble growth and have a blanched and sickly hue, compared with the same species in the free air and exposed to the rays of the sun. If one side or portion of a tree be shaded or deprived of its full share of light, it ceases to grow in its natural way, and the shoots are lean, slender and imperfect. Every part of the tree, root, branch and stem, is more or less independent of the other parts, for its subsistence. There was a marked case illustrating this on the Paragon Fruit Farm. Three rows of apple trees, two rows of Gano trees, planted in the regular order of thirty-five feet each way; between these were a row of Stayman winesap planted as fillers. These trees were coming into good bearing, but being planted thus thick, the soil failed to furnish sufficient fertility, and the trees lost their rich green color, becoming a yellowish green. In the Fall of 1904 I had several loads of second crop clover hauled and spread as a mulching, between these trees, fully three inches thick. The following season, 1905, the trees soon showed the effects. The inside half of each Gano row and the entire trees of winesap, as far as the mulch reached, assumed a dark, rich green color, made a strong growth, with large, perfect fruit; but the marked feature of the experiment was shown in the unmulched parts. The outside half of the two Gano rows, and the balance of the three rows that received no mulch remained as they were the year previous, making but little growth, with foliage badly off color, and the fruit on the unmulched halves of the Gano's was not more than half the size of the mulched portion.

In the Fall of 1905, the outside half of a portion of the Gano's was mulched. As far as this was done the trees responded promptly this Spring, sending out strong growth, with rich green foliage, while the few trees still unmulched continue their emblem of distress, showing conclusively that each portion of a tree is dependent upon the soil in which its roots are growing for its nourishment, and that one part of a tree may be overfed and another part starve. The veins through which the sap flows on one side have no connections with another part. The same thing is shown frequently in large trees, a portion of the bark on one side of the trunk may be killed by canker or from a bruise. This part will suffer, also the branch that received its nourishment through the injured part will gradually die, while the remaining part of the tree remains in perfect health.

SOIL.

Soil is the foundation upon which successful orcharding is built, therefore, it will be suitable in the start to say something about the soil and those varieties best adapted to the production of fruit. There is such a diversity of soils in all the widely separated regions, some of which seem especially adapted to the production of choice fruit, others are so wholly unfitted to orcharding that it would be folly to plant trees. Very many of these soils can, by proper treatment, be rendered suitable. If too compact, they can, by mechanical means, be broken up, thus exposing them to the action of the elements, the air, moisture, heat and freezing. If too wet, they can be drained; if lacking in fertility, the necessary elements should be applied. These different soils are designated by different names whereby we may distinguish them. It would be well to give the names and description and for what they are best adapted. For this purpose I shall take one of the counties of Pennsylvania that has the greater varieties of soils. Adams county lies along the Pennsylvania-Maryland line about midway between the east and west boundaries of the State. It has an area of 341,888 acres, or about 534 square miles. Its climate is moderate. The crops are seldom injured by early frosts in the fall, or by late frosts in the spring. The majority of this county lies south of latitude 40. The east central two-thirds of the county consists of a broad, moderately rolling valley, beginning at the southwestern portion from the Maryland line and extending in a northeasterly direction clear across the county. There is another similar one entering at the same place, extending north to Fairfield, thence northeast parallel with the first. Flanking this valley on the west and north, lies the South Mountain

range. The approach to this range is in most places abrupt, and so is the variation of soil. The county is drained by two main systems. In the northwestern part, the Conewago creek has its origin and extends easterly to Berlin in the northeastern part of the county, draining the northern half, and by its confluence with Little Conewago, the southeastern half of the county. This system is terminated on the south by a law divide between Arendtsville and Hilltown, extends southward toward Hunterstown, then southeasterly towards Littlestown. This portion is drained by rock and marsh creeks.

There are fourteen types of soils in Adams county, viz.: Hagerstown strong loam, Hagerstown loam, Penn sandy loam, Penn loam, Penn shale loam, Cecil stony loam, Cecil loam, Cecil clay loam; Porter's stony loam, Porter's clay loam, DeKalb stony loam, Cardiff slate loam, rough stony land, meadow.

Hagerstown stony loam consists of medium brown loam about eight inches deep. The subsoil consists of a heavy yellow loam gradually grading into a clay loam to an average depth of thirty inches, interspersed more or less with stone. This type occupies but a small portion of the county. The largest area is around Cashtown eastward and southeastward and a few small tracts near Fairfield. This type is derived from a cherty form of limestone, and the stone in the soil consists of pieces of chert which were originally in the limestone. This soil is well adapted to general farm crops. This type is not so well adapted to fruit. Hagerstown loam, the surface consists of mellow or silty loam from eight to twelve inches deep, ranging in color from dark yellow to brown. The subsoil is a deep yellow, often tinged with red, with a lower subsoil of deep red. This is much heavier and more compact. This soil is generally free from stone, excepting a small percentage of chert, in size from one to two inches. The Hagerstown loam is found in two parts of the county. The smaller area is found around Fairfield in the western part of the county, extending north and south. Scattered areas are also found in the vicinity of Cashtown, interspersed with Hagerstown stony loam. Hagerstown loam is derived from the massive blue limestone formation of the Cambrian-Silurian times. The rock is generally covered from three to twenty feet, but sometimes crops out on the surface. Hagerstown loam is most excellent land for the production of wheat, corn, oats and hay. Besides these farm crops, this soil produces fine winter apples. The York Imperial is probably the variety for which it is best adapted. This variety produces large crops of good color and keeping qualities, and can be depended upon. Penn sandy loam.—The largest area extends from near Littlestown southwest to the Maryland line. The Penn sandy loam consists of light, medium and heavy sandy loam, ranging from coarse to fine in tex-

ture, from six to fifteen inches deep. The color is brown, Indian red, rarely yellow, frequently with ten to twelve per cent. of fragments of sandstone. Its surface features are much varied. There is no regularity in its occurence save in the area given. It occupies the hills, slopes and valleys. It is generally associated with Penn loam, where it is found in many detached areas. The Penn sandy loam is well drained, and crops frequently suffer for want of moisture late in the Summer, but seldom early enough to injure the wheat or corn crops. The type is derived from Mesozoic sandstone and sandy shales.

Penn Loam.—This occurs in a large area extending from Berlin southwest to the Maryland line, a distance of about twenty miles; also in a long strip from Cashtown through York Springs to the York county line. The type is of a broad, gentle rolling valley, bounded on the east by the Penn shale loam and on the west by the Cecil series. In color it is of a dull red or brown silty loam, from eight to twelve inches. The subsoil consists of heavy Indian red, or light brown, from fifteen to thirty-six inches in depth. The surface soil is, in many places, a very fine yellow loam. Sandstone fragments from five to twenty-five per cent. is frequently mixed with the surface soil. When the type is derived from the soft shales, fragments of that material are found in both surface and subsoil. Penn loam is derived from the underlying beds of Mesozoic soft sandstone and shale, but there has been such complete disintegration of the rocks that they are buried so deeply beneath the surface, so that they have but little effect upon the soil and its productivity. This soil is adapted to general farm crops and far surpasses many types of soil in the production of hay, corn and wheat. Where properly drained, fruit does fairly well, but is not equal to some other types.

Penn shale loam is the most extensive type in Adams county. It occurs as a broad rolling valley extending across the central portion of the county, parallel to the South Mountain range. The surface features of this valley are sharply broken by two intrusive dikes, which give rise to the Cecil series of soils, and are rendered more steeply rolling in several sections by dikes of the same material. The surface soil of Penn shale loam consists of a dark Indian red loam, eight to ten inches deep, and is generally very uniform in texture. The subsoil consists of heavy Indian red loam, silty loam, clay loam or loam. The depth of this subsoil is variable and always resting upon shale rock, from which it is derived. In level areas of considerable size, the soil is often three feet deep and deeper at the foot of the slopes. When the surface is very much broken, the rock lies from fifteen to eighteen inches beneath the surface. The drain age is principally surface, as the water is prevented from penetrating by the underlying beds of shale. This type suffers much more

in dry seasons than in rainy seasons, because the shallow subsoil can retain but a small reserve supply of water, and when this becomes exhausted crops must suffer. In favorable seasons, with sufficient rainfall equally distributed, Penn shale loam gives good crops in the general line of farming.

Cecil Clay Loam.—The surface soil to a depth of ten inches consists of a reddish yellow or light brown clay loam. The subsoil consists of a reddish or brown clay loam grading into clay, which often contains considerable partly disintegrated rock, from which the type is derived. This character of material may extend to a depth of three feet or more, but frequently the clay content decreases below thirty inches and the disintegrated rock particles increase proportionately until the underlying rock is reached. From ten to thirty per cent. of stones and boulders, principally syenite, are commonly present in both soil and subsoil, and small areas are frequently very stony; but, in general, the amount of stones does not seriously interfere with cultivation. The Cecil clay loam occurs in long strips, which extend nearly across the entire county from northeast to southwest. This feature of the type depends directly upon the nature of the geological formation from which the soil is derived. The surface features of this type range from moderately to steeply rolling, with but small areas of level land. It usually occupies entire dikes or the lower slopes of dikes, while the upper and steeper slopes of the summits are occupied by Cecil stony loam or rough stony land. Surface drainage is rapid, and small gulleys are frequently formed and soil transportation steadily takes place, consequently, the soil is much deeper on the lower and more gentle slopes than on the upper slopes and summits of the hills and ridges. The heavy character of the subsoil makes it retentive of moisture, therefore, it withstands drought much better than soils of the Penn series. Cecil clay loam is derived chiefly from syenite, which is the principal rock of which the intrusive dikes are composed. Cecil clay loam is excellent farm land and gives good crops of corn, wheat, oats. Hay and certain varieties of fruits do very well.

Cecil Stony Loam.—The surface soil averages about ten inches in depth, consisting of heavy red or clay loam. The subsoil consists of light red loam or clay, which usually grades heavier as it recedes from the surface, but in places, after reaching a depth of thirty inches, it gets lighter into a mass of disintegrated syenitic rock. Both soil and subsoil contain from thirty to sixty per cent. of stones and boulders. The small stones are principally iron stones. Cecil stony loam occurs in small areas on the intrusive dikes, which have cut across the county. Cecil stony loam is always more or less broken and hilly. The type often occupies the steep slopes and the lower elevations of the rough stony land. Surface drainage is very

rapid owing to physiographic features of the type, and the cultivated fields wash seriously from heavy rains. The subsoil is very retentive of moisture, seldom suffering from drought. This type is derived from syenite and other metamorphic rocks of the intrusive dikes. The large part of this type is covered with forests of oak, chestnut and locust. The least stony areas are excellent fruit soil and offer good opportunities for the profitable development of that industry.

Cecil Loam.—The surface soil to an average depth of eight inches consists of medium light brown loam, often containing a high percentage of silt. This material is always mellow and when dry becomes fluffy. The subsoil consists of heavier loam, the color grades from light brown to pale red or yellow. The subsoil contains varying amounts of mica particles, which gives it a greasy feel characteristic of soils derived from rocks which carry a high percentage of mica. Finely divided mica scales are usually found in the surface soil also. Small areas are free from stones, but generally rock fragments are present. The chief part of the area occupied by Cecil loam is moderately rolling to hilly. Gentle slopes of considerable extent are common, but there are also numerous hills and knolls which give to the type a varied aspect.

The Cecil loam is derived chiefly from mica schist and chlorite schist rocks. The latter predominate in the extreme southeast corner of the area, and are bordered on the north by the former, but they are so intermixed that the soil resulting from their decay is very uniform. This section was known as the barrens, as it was destitute of large timber and was considered unproductive; but when it was developed it was found to compare favorably with the limestone valleys. The soil is warm and can be worked earlier in the spring than the heavier soils. It produces good crops of corn, wheat, rye and hay. This soil seems to be especially well adapted to the production of the peach, and this industry could be made very profitable.

Cardiff Slate Loam.—The surface soil to a depth of eight to twelve inches consists of heavy, fine loam to clay loam, varying in color from blue to gray. From ten to forty per cent. of slate particles and small fragments are contained in the surface soil. The subsoil consists of a silty clay loam, grading into light grey, but usually the small fragments of slate increase in depth, and at three feet or more rest upon the steeply inclined rock. The Cardiff slate loam occupies a long, narrow ridge in the Conewago valley, where it leads toward the Pigeon Hills, and also a broader area between the valley and the Cecil loam formation south of it. In the former position it represents an intrusive dike, and in the latter it is derived from similar slate rock, which outcrops along the northern border of the Cecil loam beneath the metamorphosed mica schist formation. Cardiff slate loam is most excellent fruit land. Both the apple and

peach do well, and all this stony land could be converted into profitable orchards.

Porter's Clay.—The surface soil of Porter's clay consists of a heavy loam or clay loam, brown or dark grey in color, from six to fifteen inches deep. The subsoil consists of pale red or light brown clay loam or clay. From fifteen to twenty-five per cent. is stones, and angular rock fragments are usually present in both the soil and subsoil, but never large enough to interfere with cultivation. The Porter's clay is found in Adams county in the South Mountain range and along its lower slopes to the east and south, and also in the Pigeon Hills in Berwick township. The largest area lies in the extreme northern part of the county, where the South Mountain passes into Cumberland county. The land is moderately rolling, and although the level areas are small in extent, yet little of the type is so steep as to be troublesome farming. In the mountains this soil is found in the valleys and coves, where these are broad, and the slopes to the surrounding mountains are only moderately rolling. For some distance the type appears in considerable areas, but where they are narrow it is found only in small areas or displaced altogether by the Porter's stony loam.

The Porter's clay is derived from rocks of the Archean age, of which the South Mountains are composed—chiefly gneiss, orthofelsite and quartzite. Along the east and south slopes of the South Mountain range and just along the lines of contact between the Archean rocks of that formation and the Mesozoic rocks that lie below it are the most important areas of Porter's clay. Certain parts of these areas. seldom large, are derived principally from the rock locally known as copperstone. These tracts popularly termed copperstone land are very much more productive than the general type, and are considered nearly equal to the limestone soils. The copperstone phase and the adjoining part of the type along the lower mountain slopes are excellent soils for general farming and are well adapted to fruit raising. There are great variations in the productiveness of different sections. This is often due, not so much to the natural productivity of the soil as to its management. The farming is done on a much more intensive manner along the foot of the mountains from Cashtown to York Springs and thence to the northern part of the country, and the crops yield accordingly.

Porter's Stony Loam.—The surface soil consists of light to heavy brown loam or clay loam, from eight to twelve inches deep. The subsoil is heavy loam, but with increasing depth grades into a clay loam which extends to a depth of about thirty-six inches. The stone contents vary widely. The most level portions contain from twenty to fifty per cent. of gneiss fragments, quartz conglomerate, etc., with but few large stones. The gneiss fragments are mostly small, hence

commonly termed as mountain gravel land. The ridges and steep slopes are more stony than the level portions, and often lead to rough stony land on higher slopes or tops of hills and ridges. A lighter phase of this type occurs in several instances on hills and ridges scattered about the true type. The soil consists of medium sandy loam to a depth of eight inches, and contains from thirty to seventy per cent. of stone. These stones are chiefly flaggy sandstone, with lesser amounts of quartzite. The subsoil is heavy sandy loam, or loam underlain with clay loam at varying depths from twenty-four to thirty-six inches.

The Porter's stony loam is found in the western and northwestern parts of the county, where it occurs either among the hills and ridges of the South Mountain range or on some of the outliers of that range. The topographic features of the type are much diversified. In general, its moderately or steeply rolling surface is much broken by many steep-sided hills; the tops and upper slopes are rough, stony land.

The Porter's stony loam is derived principally from the gneiss, orthofelsite and quartz conglomerate rocks included in the South Mountain range. The materials resulting from the rock decay is largely in places of the more level positions, but on the steep slopes the surface soil has been modified by the agencies of soil transportation. Fair yields of general farm crops are obtained.

Porter's stony loam is preminently adapted to the production of fruits. Trees thrive and fruit of the best quality is produced. Wherever the apple is planted upon the Hagerstown loam, Porter's stony loam and Porter's black loam, the owner can rest assured that, if he does his part, success will crown his efforts. No matter where we find these soils, whether in Pennsylvania, Virginia, or other states, orchards well selected, planted and cared for, are bonanzas to their owners.

In Virginia, the noted Albemarle region lying between latitudes 37° 45′ and 38°30′ north and 78°30′ and 79° west longitude, of which there is no better apple districts in the United States. The Porter's stony loam and Porter's black loam are there known as the pippin land, as in these soils, with an altitude from 1,000 to 1,500 feet, the Albemarle or Newtown Pippin (the apple that is so choice of soil, climate, etc., that it can be grown in but few places) is there grown to the highest state of perfection. The choice of soil for this apple is Porter's black loam where it occurs in sheltered mountain coves, where the soil is rich, mellow and deep—all of which is essential to the productiveness of this variety. They will produce an excellent crop on the Porter's sand and Porter's clay, but produce on alternate years, whereas on Porter's black loam they produce a crop every year with less care; but, with few exceptions, all the soils are adapted to

fruit growing. There are types of soil, however, that are particularly adapted to certain varieties of fruit. Until recently, planting was done without regard to location or adaptability of soil to the different varieties, but now intelligent growers recognize the adaptation. Instead of planting large blocks of one particular variety, there will be several varieties planted in places suited to each. Thus, certain localities often become famous for the production of certain fruits. Adams county is noted for producing the York Imperial of higher color and better quality than any other section, but this apple also has its preference to soil. In Virginia it does best in the valleys and especially upon Hagerstown loam. On the eastern side of the Blue Ridge it ripens too early and does not have as good keeping qualities. In the valleys this fruit is a thrifty grower and gives large yields. The fruit is large and has fine color and flavor.

In Adams county large quantities of apples, and specially York Imperial, are grown along the foot of the South Mountains, near Cashtown, and from there to Bendersville. Upon examination of soils, we find the same variety of soil exists. At Cashtown there is a triangular area of Hagerstown stony loam, to the west of this is a narrow strip of Hagerstown loam, and to the west of this is a large area of Porter's stony loam. Around Arendtsville is a large area of Cecil clay, and to the west a strip of Porter's clay, and west of this, Porter's stony loam. As we move farther northeast to Bendersville, the same conditions exist. Bendersville is surrounded by a large area of Porter's clay, and this bounded on the northeast, northwest and southwest by Porter's stony loam. A short distance south, at Floradale, we find quite a large area of Penn loam, and on the west a strip of Porter's clay, which is bounded on the northwest by Porter's stony loam. Thus, we find where these soils exist the apple is at its best, and any one having these soils with good drainage will find the propagation of the apple the most lucrative business to engage in.

DeKalb stony loam consists of brown, yellow or gray medium sandy loam, from six to ten inches deep. The subsoil ranges from heavy yellow sandy loam to light red clay loam, resting upon a mass of sandstone and quartzite fragments. The depth of the subsoil varies greatly, ranging from fifteen inches or less on the hilly land, to thirty-six inches on the level portions, as in the northwest corner of the county. From twenty-five to fifty per cent. of the rock fragments are scattered over the surface and mingled with the soil and subsoil. There are few large stone, and these are usually found on the steepest positions. The most important area of DeKalb stony loam is found in the extreme northwest corner of the county, where it occupies a small tableland and part of the escapement leading to it, with steeply rolling land adjoining. Another area lies along Conococheaque creek and Birch run, occupying the valleys of these

streams, and the foothills and lower mountain slopes on each side. DeKalb stony loam is derived from quartzite, quartzose sandstone and conglomerate. The quartz particles are very firmly cemented together, and consequently break up slowly. This land is lacking the qualities favorable for heavy crops of grain and fruit, although some peach orchards have been planted with fair success.

Rough Stony Land.—This land has the least value of any of the types. It is too rough and stony to be utilized and is left to forest. Large areas of these lands are found in the South Mountain, usually associated with Porter's stony loam or Cecil stony loam.

Meadow.—This is valuable for pasture and hay, not much used for farm crops or fruit.

Before leaving the soils, it might be well to compare those spoken of in description of soils of Adams county, with the soils of Lancaster, Dauphin, Lebanon and other counties. Leaving Reading, via Philadelphia and Reading Railroad, over the Lebanon Valley branch, we pass through one of the richest agricultural districts in the state. These beautiful limestone valleys, once heavily timbered with oak, hickory and walnut is now almost cleared and occupied by well-kept farms, ranging from forty to two hundred acres, averaging about eighty-five acres.

Eleven types of soil are included in Lebanon, Lancaster and Dauphin counties, eight of which are resident soils derived from sandstone, shale, trap and massive limestone rocks. The remaining three —Donegal gravel loam, Lickdale clay loam and meadow—are of sedimentary character, associated principally with stream action.

The larger portion of Lancaster and Lebanon valleys is composed of Hagerstown loam. In the latter locality it is from two to seven miles broad and about thirty miles long. The northern edge of this area passes through the city of Lebanon, while the southern edge reaches the South Mountain range. The altitude in Lebanon and Dauphin counties is from 450 to 640 feet above sea level. As in the other sections of the same type, fruit of all kinds, especially the apple of certain varieties, do well. Tobacco is one of the special crops of these valleys.

Hagerstown shale loam occurs along the northern border of the limestone valley in Lancaster county, and joins the sandstone ridge to the north along the county line. In Lebanon and Dauphin counties it forms the northern half of the Lebanon valley. In the latter valley, the area is about thirty miles long and from six to ten miles wide. It is bounded on the north by the Blue Mountain, and on the south by the limestone formation on a line passing through Meyerstown, Lebanon, Palmyra, and Harrisburg. The area of this type covers over 142,000 acres of well-rounded hills and ridges, with V-shaped valleys.

The Hagerstown shale loam can be tilled in almost any condition, due to the presence of soft shale fragments in the soil. This type of soil is known as "gravel land." It was originally covered with chestnut and oak timber. The land was not held in high esteem, but with good treatment and sufficient manure it compares favorably in yield with the limestone soils; a good quality of leaf tobacco is produced. This soil is particularly adapted to small fruits and general orcharding. There is a large area of valuable land that, when the owners realize the possibilities of commercial orcharding, can be made to bloom as the rose, and yield incomes beyond the wildest dreams of the sturdy farmers, who now, by hard labor and close economy, manage to pay taxes and exist. Lebanon, Lancaster and Dauphin counties have varieties of soil not yet described.

Edgemont Stony Loam.—The main areas of this type occur upon that portion of the Blue Mountain north of the Hagerstown shale loam last described, also upon that portion of the South Mountain range, along the northern boundary of Lancaster county. Its surface is distinctly stony and mountainous in character. The elevation above the general valley level ranges from 200 to 600 feet, and from 600 to 1,200 feet above sea level.

The soil is derived from the slow disintegration and decomposition of the quartzite and quartose sandstone and conglomerate. The Edgemont stony loam varies from a loamy soil to a coarse sandy soil eight to ten inches deep, underlaid with solid ledges of rock or broken masses of rock and earth. The amount of rock fragment of the surface varies from twenty to ninety per cent. Some of the sandy loam phase of this type are freer from stone and admit of the raising of general farm crops, but, in general, the Edgemont stony loam is adapted only to orcharding and forestry. The native forest growth now consists of chestnut, interspersed with dogwood, oak, pine, hickory and walnut. The soil is well suited to growing chestnuts and peaches, and some excellent peach orchards are now established upon it. The chestnut sprout land is being, to a small extent, grafted to some of the large varieties, as the Paragon, etc. The great difficulty met with in the production of the chestnut are the forest fires and the insect foes; but, as in the Hagerstown shale loam, the apple will be the standard money crop.

Donegal Gravelly Loam.—This type occurs on the older formations, lying along the Susquehanna river. There is considerable variation in the surface. Where the limestone formation borders the river, the terracing is more gently rolling, varying in elevation above the river from ten to sixty feet. Where the shale and sandstone reaches the river, the surface is more hilly and the elevations are sometimes as much as 100 feet. This type extends back from

the river from one-eighth to one mile. Harrisburg is situated on a well-defined terrace. The terraces are thought to have been deposited by the Susquehanna during the close of the glacial epoch, when the northern portion of the state was covered with melting ice. The depth of soil ranges from three to twenty feet. It varies from a gravelly to a sandy, or even a heavy loam texture. A sandy loam with occasional gravel seems to be the predominating type. It is considered very good soil for all crops, and many varieties of fruit do fairly well upon it. It is an open, warm soil, especially adapted for trucking.

Dauphin Sandy Loam.—This type occurs surrounded by Hagerstown shale loam. It is more sandy in nature. It is of a yellowish gray sandy loam. It extends as a narrow, broken strip from Bunker Hill to Harrisburg. It is considered very good soil, and about the same crops are raised as on the Hagerstown loam.

Lickdale Clay Loam.—This is generally flat, poorly drained land. It occurs along streams at the base of the Blue Mountains. The area is only about six square miles. When undrained it is suitable only for pasture and hay; when artifically drained it brings fair crops of wheat, corn, oats and potatoes. The more northern counties consist principally of the same soil, but varying in extent, for instance, take Clinton county. The largest acreage of any of the soils is DeKalb stony loam, which covers nearly all the area of the southern portion of Clinton county, bounded on the east and extending into Lycoming county, on the south and west by Center county also extending into that county, and on the north by the Bald Eagle valley. The great portion of this area is mountainious and very rough and broken, of little value for farming; but there are sections of this area comparatively free from stone and very easily tilled. There is a large area of this type north of Loganton, which is well drained and when properly cultivated produces fair crops of potatoes of the finest quality, and apple orchards, if sprayed and cared for, would produce fruit equal to the best. This soil is the same as the great peach belt of western Maryland, and the time is not far distant when the farmers of this locality will awaken to the fact that this soil, so long considered worthless, will, with intelligent development, prove a veritable bonanza. With the favorable climate of Clinton county, with the rich Bald Eagle valley, with its large acreage of Norfolk loam and Norfolk silt loam, made up of sediment deposited at times of high floods, averaging from eight to fourteen inches in depth of surface soil, of which there is no better in the state. North of this is a large area of Hagerstown shale loam, noted as the great soil wherever found. A few miles south is the noted Nittany valley, with its large area composed of Hagerstown shale loam. A few miles south of this is

the Sugar valley with the same variety of soil, also noted as excellent fruit soil when properly drained, which these two valleys are, by Little and Big Fishing creeks, which empty into Bald Eagle creek, thence into the West Branch of the Susquehanna. This large scope of country, once covered with her great wealth of forest, but with her hills and mountains now almost denuded of timber through the waste and avarice of man who, in his shortsightedness, wasted more than he utilized and left to his children a heritage of desolation and poverty—these same hills will again be resplendent with fruits of a different type, for large areas will be planted to apple, peach and various other fruits, and prosperity will reign.

If time permitted, we might fill pages in treating of the various soils in the different counties, there being between four and five hundred definite kinds of soil in the United States. Yet, strange as it may appear, if we turn to any census bulletin or statistical account of crops produced in the United States, you will be surprised to note that only twelve or fifteen staple crops are produced in sufficient quantities to be considered important enough to report.

Here in the United States, with several hundreds of different kinds of soil, with a range of rainfall varying from two inches to one hundred inches per annum, with a climate varying from subtropical to subarctic, with altitudes ranging from sea level to a few thousand feet above sea level, with a great diversity of agricultural requirements, we are only producing upon any large scale a dozen, or, at, most, a score of important agricultural products. The American must learn, as many European farmers have learned, that the safest and most profitable agriculture is based upon a considerable diversification of crop interest and upon a careful selection of the crops which shall be raised upon any given soil under its existing climatic conditions for any particular market. When diversification can be thoroughly worked out and the crop adaptation to the soils thoroughly ascertained, we shall hear less of good years and poor years of agricultural prosperity and agricultural failure, because through diversification we shall be able every year to secure good crops upon every farm.

In Pennsylvania, as in every other state, we have a very serious problem, which we may call the adaptation of the crop to the soil, that is, to select the proper crop to the proper soil. The question is frequently asked, "What is the best soil in the United States?" That is a question that cannot be answered. We know where there are some of the best soils for corn, some of the best soils for wheat, for potatoes and for fruit, but soils that are best adapted to some crops are not at all suitable for others. The best soil for corn is not the best soil for peaches or sweet potatoes. If I were asked if the rich Hagerstown loam soil of the Lebanon valley was good

soil, I would assuredly answer yes; then, if I were asked if the light sand along the Atlantic coast was good, I would say yes. But the two soils are not at all alike in their adaptation or their agricultural uses. The Hagerstown loam is the very best corn land, but very poor for sweet potatoes and none of the best for peaches. The sandy soils along the Atlantic coast are the very best for the sweet potato and worthless for corn or oats. Soils are not intrinsically good or intrinsically poor. They are good for one crop and poor for another, and the successful farmer is the man who knows what crop to raise on a particular soil or class of soils, and who knows enough about that crop to produce it to the best advantage.

SOIL FERTILITY.

This is one of the great problems that confronts the eastern farmer and fruit grower at the present time. No one, not even the scientific investigator, can place his finger on any one factor which constitutes soil fertility or the lack of soil fertility. Certain things we know about the crop producing power of the soils. We know, for example, that in many cases the absolute yield of the crop does not actually increase the full ability of the soil to produce the crop that is, even when the soil is in its best producing condition, there may be unfavorable conditions of climate or insect pests or fungus diseases or low germinating power of the seeds or plant, all of which will affect the crop production adversely, while the soil may be in the very best condition to produce any good crop.

For that reason I would like to call your attention to the fact that the soil is very much like a steam boiler, the capacity of which is measured by horse-power, and we say that such and such a boiler has a capacity of 100-horse-power, that is, it can be safely run to that limit. Now, if the boiler is properly handled by a competent engineer, it will continue to develop one hundred horse-power and deliver it to the engine for a long time. If, however, we take off our skilled engineer and put in his place a cheaper man to run the boiler, it may, and very frequently does result, that the cheaper man will not secure near the horse-power from the boiler. It is much the same with soil. Given the same soil on two adjacent farms, one handled by an adept farmer, a past-master in the art, he will get maximum yields annually, and the other, handled by a less experienced, but perhaps no less industrious laborer, will fail to secure beyond seventy-five per cent. of the crop of his successful neighbor under almost the same conditions. The soil cannot be blamed for this. It is simply the difference in the capability of the men to handle the soil.

This more frequently happens in orcharding than any other branch of farming. Two men owning adjacent farms will set out

peach orchards with merely a fence between them, the soil being the same, the elevation being the same, perhaps the varieties the same; the one, from some cause, takes the lead from the start, coming into bearing, often yielding a basket to the tree in thirty months from time of planting, with an annual increase in yield for many years, proving a veritable gold mine to its owner. The other fails to make satisfactory growth, the foliage lacks the rich green color so noticeable in a healthy peach tree; lacking vitality, it fails to mature strong buds, or the severe winter kills back the tender wood; the bloom that opens frequently fails to set fruit, or, if it does, the larger portion falls during the June drop, and what remains is attacked by fungus diseases, rendering it worthless. The orchard dies a lingering death without having produced sufficient fruit to pay for the labor expended. This difference may arise from previous training, from lack of intelligent comprehension of the crop requisites. No matter what the cause of difference may be, the soil frequently has to bear the blame, or the term "luck" is applied. Holding this in mind, let us review some of the characteristics of soils which we usually associate with high fertility. Throughout a large part of the United States the dark-colored loams and clay soils contain a large amount of partially decayed matter and humus, which are associated in the popular mind with a high degree of fertility. And there is a basis of fact in this. Nevertheless, we must hold in mind that some of the most fertile soils in the United States, those of Southwestern Arizona and various portions of California, have so small an amount of organic matter present that they may be practically said to be lacking in it. Some people say that a soil rich in potash is a fertile soil. Others say a soil must contain a large amount of phosphoric acid to constitute a fertile soil. In any case, it would be difficult to prove whether this is true or not.

The result of long and persistent investigation of the chemical properties in the soils of the major portion of the United States has been the conclusion that all soils within a zone contain from the surface to a depth of four feet sufficient mineral plant food to produce the ordinary farm crops for a period of one hundred or more years. When we take into consideration the fact that almost all agricultural soils are subject to a constant process of removal at the surface by means of erosion and that they are as constantly being renewed by the preparation of more soil from the underlying subsoil, we will see that the great majority of soils are capable of maintaining their fertility if they are only handled properly and given a slight amount of assistance by those who are farming them. That is, the careful farmer will so plan his agricultural operation that he maintains a proper amount of organic matter in

his surface soil, and depend upon the great process of nature for proper mineral plant food for soils which must be used for succeeding crops. That this can be done we are reasonably certain, for before the use of artificial fertilizers, which has been only during the last hundred years, agriculture had been carried on in many portions of the world for periods of two or three thousand years without any material diminution in the crop yield. This was only done by thorough and systematic tillage and by a careful saving of the original manures. If we can supplement good cultivation and the use of organic manures with other substances cheaply produced and rapidly applied, we have made a decided progress in scientific agriculture. This has been done through the use of so-called commercial fertilizers during a period of about one hundred years. But, so far, we have no systematic method of using the fertilizers. There is too much guess-work. If I buy a piece of land in your vicinity, can any one tell me what fertilizers to apply? Some of you who live close by can. Why? Because you have learned by experience in handling these soils and by the production of definite crops the class of fertilizers which can be used to the best advantage. This cannot be done, this advice cannot be given, from the results of any chemical analysis. No one can tell by the appearance of the soil. One must try the fertilizer upon a particular soil and a particular crop to get the answer from the plant itself. There are several factors in crop production, whether fruit or the cereals, and the soil which is best adapted to that particular crop in one locality, in one state, may not be the best soil under the climatic conditions. We have found also that soils of different regions, which differ considerably in their characteristics, may still be so handled with different methods of tillage that they will produce the same crop to reasonably good advantage. That is the method of raising the same in the heavier black loams of the Central states. It is possible then not only to adapt the crop to the different soils, but it is also possible to adapt the method of tillage to both the crop and the soil, equalizing what would otherwise be divergent capabilities of the soil.

I believe that every farmer and fruit raiser should have a large scale map of his farm, that is, a chart so drawn that every square inch represents an acre of his land. This chart shall contain all the fields, the buildings, the orchards, the woodlands and other physical features of the place. He should have another chart upon which should be indicated the different kinds of soil, the loam in one part, the sand in another part, and the clay in another part of the farm. He should then keep a complete record of the results which he has secured for each year. At the end of ten years the man who kept such a record would be, in spite of himself, a scientific

farmer, that is, he would be a farmer who knows, and not a farmer who guesses.

The majority of people look upon soil as a thing that is unclean, or it is so commonplace that they are inclined to look upon it as of less importance than is consistent with their good. This is also true of air and water. In our search for information by the application of which we may be enabled to produce better crops, whether of the plants of animals, we are too much inclined to overlook the commonplace things, those basal essentials, air, water and soil. They are necessary to the production of all forms of life, and to control and utilize them they must be rightly understood. The soil proper is the surface layer of the earth and rests upon the subsoil. The thickness of soil is quite variable and may be several feet deep in alluvial deposit or entirely wanting when removed by erosions, as found on many of our hillsides.

A fertile soil is one that contains an abundance of available mineral and organic matter and is in the proper physical condition for the production of good crops. One soil may contain all the necessary elements of plant food for the production of maximum crops and be unable to produce them. Another may contain a meager supply and yet be highly productive. In the first case, the plant food is in a form that the plant cannot utilize it, while in the second it is available. Large quantities of plant food have been stored in the soil since its creation, and awaits its liberation that it may perform the functions for which it was created. There are but few soils that do not contain an ample supply of the elements of plant growth to reward the patient and wise tiller of the soil, and it is his privilege and duty to secure the best returns for his labor and lands with as little waste of each as possible. We must look upon the soil as a factory in which are manufactured the plants we grow for various purposes. That we may annually secure abundant and prolific returns, this factory must be kept in good working condition and amply supplied with raw material for the production of plant growth. The fertility of a soil is its power to produce crops and is controlled by the depth and texture of the soil and by the quantity and availability of the plant food and moisture. The necessity of a deep soil is at once apparent. The soil upon which any crop is to be grown should be of sufficient depth to permit the exercise of the full functions of the root systems of the crop. A shallow soil is capable of holding less plant food than a deep one, and it is easier for it to lose that which it has. It is capable of holding less moisture and loses moisture more rapidly and suffers to a greater extent from washing. Depth of soil is increased and maintained by deep plowing and by the growing of deep-rooted plants, and by preventing its being washed away by heavy rains. One heavy rain fall-

ing upon a bare and freshly cultivated soil will do more damage in the way of removing plant food than will result from growing several crops. Deep plowing must be done with sound judgment, or it will fail to produce the desired results. But few shallow soils will show immediate beneficial results from deep plowing, since the bringing to the surface of too great a quantity of subsoil of average texture will so impair the texture of the soil proper as to counteract the benefits of deepening the soil. When a soil is broken deeper than it has been broken before, it should invariably be done in the fall or early winter that the weathering effect of freezing may crumble and digest the harsh subsoil brought to the surface. Deeper plowing should be accompanied by the plowing in of a sufficient quantity of organic matter to at least maintain the physical properties of the surface soil. When the depth of soil is to be increased by deeper plowing, the nature of the plow used should be such as will not invert the furrow slice, but leave it on edge, turning just past the vertical to prevent falling back in the furrow. In this position subsequent manipulation will thoroughly incorporate the recently elevated subsoil with the soil proper. The deepening effects of tap-rooted plants is of great importance: the clovers, cow peas, etc., send their roots down deep into the subsoil in search of mineral matter and moisture. They not only leave this food, for which they have foraged, near the surface, but the death and decay of their roots leaves the subsoil punctured with thousands of capillary tubes that facilitate the passage of water and dissolved or suspended plant food, draining excess of water from the surface into the subsoil to be brought back to the surface when needed. Air circulates more freely, and better conditions for nitrification are secured.

The texture of soil is of no less importance than its depth. A soil might be five feet deep and abundantly supplied with all the necessary plant food and yet produce poor crops if the texture is bad. The texture of soil is its physical condition, loose or tenacious, hard or soft, cloddy, leachy, baking and the like. A soil has good texture when the grains that compose it are neither too small nor too large, and are not too closely cemented together. Thus, a sandy soil is composed of coarse grains that readily move upon each other. They are easily washed and readily take up or lose plant food and moisture. A clay soil is composed of minute particles that may be too prone to cement themselves together, thus becoming difficult under cultivation, harsh and not easily penetrated by the roots of the plants. Either extreme is objectionable, while an admixture of the two in about equal proportions constitutes the basis for an ideal general purpose soil. The most expedient and economical means of improving the texture of the soil consists in the incorporation of organic matter, thorough preparation and fining fall plowing,

all followed by frequent and shallow cultivation and crop rotation. The incorporation of vegetable matter with a stiff, tenacious or hard soil makes it more open and friable, while vegetable matter incorporated with sandy soils makes them more stiff and compact. In each case the tendency is to bring about a happy medium.

Why are the soils from which forest has been recently removed capable of producing, notwithstanding the hindrances of a network of roots? It is because of its good physical condition, good texture and abundance of available plant food, the result of the large quantities of vegetable matter, or humus, that the forest accumulates and maintains upon the soil's surface, in obedience to the first law of nature—self-preservation. The dominant growth of a forest represents the "survival of the fittest." Nature is ever mindful of the preservation of the soil's fertility. She prefers that the face of the earth be covered with forest. When a man, by mismanagement, wears out his once fertile fields and throws them back in Nature's hands, she at once begins the work of restoring their fertility. Her work is slow, but sure, and it is accomplished by rotation of crops. On different soils and in different climates she uses different crops in her systems of rotation. In planning this rotation, Nature first selects plants of rather prostrate form that both root and branch hold the soil's surface, and catch the leaves and whatever vegetation the winds may bring from nearby areas. Next she selects a more bushy form, the growth of which has been made more possible by their antecedents and so on through the system of rotation. Each plant prepares for those that are to come, until the forest is made, and the whole area is mulched with decaying vegetable matter and protected from washing.

Just here is found one of the most important lessons that Nature teaches—the importance and necessity of humus. More than anything else does humus cure the ills that soil is heir to. It adds to the depth of the soil and makes it warmer, checking sudden changes of temperature; it makes stiff and hard soils loose and pliable, it makes loose soils more compact, more quickly and perfectly than any other means does it produce good texture and desirable physical properties. It adds plant food in its most available and desirable form, catches and holds moisture that falls from above or rises from below, assists in aerating the soil, supplies oxygen, carbonic acid and other gases and liquids that act upon the particles of the soil, liberating additional plant food. It produces the condition favorable to the existence of the many micro-organisms so conducive to plant growth and facilitates nitrification. The addition and maintenance of humus in the soil comes more closely than anything else in farming operation to the bringing about of the ideal

soil condition for profitable plant growth. The majority of the so-called poor soils become fertile when supplied with an ample quantity of humus. Humus is applied to the soil in three ways: First, by the direct application of humus-bearing materials, such as stable manure, compost, leaf mould and the like; second, by the means of the bi-products of crops which are left on the land, such as stubbles, roots, sod, fallen leaves and weeds; third, by means of crops grown and plowed into the soil for that purpose, such as clover, cow peas, buckwheat, rye and the like, and generally referred to as green manuring. While the practice of these three methods benefits the future crops to a great extent by leaving quantities of readily available plant food near the surface of the soil, the greatest benefit is due to the improved texture resulting from the decomposing organic matter and increasing the capacity of the soil for water. If we closely watch Nature's plan, we find that she attempts in every possible way to clothe the surface of the land with vegetation, and that she succeeds if man does not interfere. Of the many things the horticulturist should know, none are greater than how to maintain the fertility of the soil.

FERTILITY ABSTRACTED FROM THE SOIL.

It has been estimated that a crop of two hundred bushels of potatoes removes from the soil about forty-six pounds of nitrogen, twenty-one pounds of phosphoric acid and seventy-four pounds of potash. The average value of fertilizing elements taken from an acre of soil by apple trees during the period of twenty years, counting in ten crops of fruit, is, approximately, $318.50. Of this amount, $124.21, or a little less than thirty-nine per cent. is in the fruit; $133.78, or about forty-two per cent. is in the leaves, and $60.51, or about nineteen per cent. in wood for the growth of the tree. The total amount of nitrogen, exclusive of that used in the growth of trees, is about 1,300 pounds; of phosphoric acid 310 pounds; of potash about 1,900 pounds per acre. To restore the potash alone as above and that used by the growth of the tree, would require over nineteen tons of high grade wood ashes containing five per cent. potash. To restore the nitrogen would require over thirteen tons of commercial fertilizer, containing five per cent. of nitrogen. In view of these facts and also of the large amounts of fertilizing elements removed by crops of hay and grain, etc., without giving it extra feed, it is not strange that orchards all over the State are deteriorating. Of course, the fact should be taken into account that a portion of the material above referred to is returned to the soil in the way of fallen fruit and leaves. But, with a liberal allowance for these returns, the value of fertilizing elements actually removed from the soil during the period named will not fall far short of two hundred dollars, or ten dollars per acre per year.

It is an assured fact that thorough tillage will render a portion of the plant food in the soil available. It may also be stated that trees have also the power to abstract this natural store of fertility, but there is a limit beyond which the tree cannot go without help.

In studying the methods of fertilizing orchards, the same general principles hold good as in other farm crops. The essential constituents are the same; but, unlike ordinary farm crops, the orchard crops do not give the opportunity for rotation. A certain amount of nitrogen is essential to the vigorous growth of foliage upon which depends the life of the tree. Potash is also important, not only because it constitutes a large part of the ash of fruit trees and more than half of the ash of the fruit itself, but also, as suggested by Prof. Voorhees, because it forms salts with the well-known acids. Lime is also very essential. It seems to strengthen the stems and woody portions of the tree, to shorten the period of growth and to hasten the time of ripening. Fruit trees growing in soils rich in lime show a stocky, sturdy, vigorous growth and fruit ripens well, while those on soils which contain but little lime, particularly the clays, appear to have an extended period of growth, the result of which is that wood does not mature and the fruit does not ripen properly.

COMPOSITION AND FUNCTIONS OF SOILS.

The substances which constitute the soils "are certain compounds of the earth, silica, lime, alumina, magnesia, and of the oxides of iron and magnesium; animal and vegetable matters in a decomposing state and saline acid or alkaline combinations." With our present knowledge of the various elements composing the soil, we may describe them as follows: Silica is a compound of oxygen and silicum (chem. silicon dioxide, S1O2). It constitutes ordinary quartz. Lime is said to exist in soils usually united with carbonic acid (chem. oxide of calcium); the white or gray substance called quicklime is obtained by calcining limestone, the heat driving off the carbon dioxide and leaving lime. It develops great heat by slaking with water; this is the form in which it is generally applied to land. It is also united with phosphoric acid, as phosphate of lime, bone, South Carolina and Florida rock, etc. It is also combined with sulphuric acid, as in gypsum, which, when ground, is known as land plaster. In the earlier part of the last century this was extensively used in agriculture by applying it to corn and clover. It is an excellent absorbent of some of the gases and is very beneficially used in stables to prevent the escape of the ammonia. Alumina, with less accuracy, is described as being composed of two parts of aluminum and three of oxygen (A12O3). It is a constituent of a large part of the earthly silliceous minerals, as the feldspars,

mica, etc., commonly spoken of as clay, and when blended with sands form the various loams or clay loam, sand loam depending upon which predominates. Magnesia is described as existing in combination with carbonic acid. Two oxides of iron are mentioned, the brown and the black. The oxide of manganese is stated to be distinguished from the other substances found in the soil by its property of reducing muriatic acid and converting it into chlorine. Vegetable and animal matters are to be known by their sensible qualities and by their property of being decomposed by heat. The saline compounds of soils are described as common salt, sulphate of magnesia, sometimes sulphates of iron, nitrates of lime and of magnesia, sulphate of potassium and carbonate of potassium and soda.

Soils are necessary for the existence of all plant life, both by affording them nourishment and enabling them to fix themselves in such a manner as to obey those mechanical laws by which their radicals are kept below the surface and their leaves are exposed to the free atmosphere. Plants, having no power of locomotion, can grow and thrive only in places where they are supplied with food. As the system of roots, branches and leaves is different in different vegetables and plants, so they flourish best in the various soils adapted to their use. Such plants as the potato and other bulbous roots require a looser and a lighter soil than such as have fibrous roots, and the plants possessing only short fibrous radicals demand a firmer soil than those that have tap roots or extensive lateral roots.

Vegetable or animal matters when finely divided not only give coherence, but likewise softness and penetrability; but neither of these or any other part of the soil must be in to great proportion, and a soil is unproductive if it consists entirely of impalpable matters; pure alumina or silica, pure carbonate of lime or carbonate of magnesia are incapable of supporting healthy vegetation. No soil is fertile that contains as much as nineteen parts out of twenty of any of the constituents that have been mentioned.

In all cases the ashes of plants contain some of the earths of the soil in which they grow, but these earths, as may be seen by the ashes when the plant is consumed, never equal more than one-fiftieth of the weight of the plant. If they be considered as necessary to the vegetable, it is as giving hardness and firmness to its organization. This may be mentioned, that wheat and many of the hollow grasses have an epidermis principally of the silicious earths, to strenthen them and defend them from the attacks of insects.

The power of soils to absorb water from the air is much connected with the fertility. When this power is great the plant is supplied

with water in dry seasons, and the effect of evaporation in the day is counteracted by the absorption of aqueous vapor from the atmosphere by the interior parts of the soil during the day, and by both the exterior and interior during the night.

Water and the decomposing animal and vegetable matter, with the soluble mineral elements, constitute the true nourishment of the plants; and as the earthy parts of the soil are useful in retaining water, so as to supply it in the proper proportion to the roots of the plants, so they are likewise efficacious in producing the proper distribution of the animal and vegetable matter. When equally mixed with it they prevent it from decomposing too rapidly and by their means the soluble parts are supplied in proper proportions.

The best soils, those that respond quickest and retain their fertility longest, are those of which the materials have been derived from the different strata, which have been minutely divided by air and water and are intimately blended together; and in improving soils artificially the farmer cannot do better than to imitate the processes of nature. The material for the purpose is seldom far distant, as coarse sand or gravel is common below clay, and a few loads of this scattered over and mixed by plowing is not a heavy task. The labor and expense of improving the texture of the soil is amply repaid by its great permanent advantage; less manure is required and its fertility insured. The capital laid out in this way secures forever the productiveness, and, consequently, the value of the land.

The fundamental principles demonstrated are these, that the productions of the soil derive their component elements, which, for the most part, are hydrogen, oxygen and nitrogen, from the atmosphere by which they are surrounded or from the soil in which they grow. The process of vegetation depends upon the perpetual assimilation of various substances to the organs of the plants in consequence of the exertion of their living powers and chemical affinities, stimulated chiefly by moisture, light and heat. Plant food is of no consequence unless the plant can use it. The hardest rocks may contain plant food in abundance, and yet plants cannot grow upon them. A stick of wood contains potassium and phosphorus and nitrogen, and yet nothing grows upon it until it begins to decay. Soils which the chemist may pronounce rich in plant food may grow poor crops. In other words, the chemist cannot tell what a soil will produce, he can only tell what it contains.

The texture or physical condition of the soil is nearly, if not quite as important as mere richness in plant food. Every good farmer knows that a hard, lumpy soil will not grow good crops, no matter how much plant food it contains. A clay soil that has been producing good crops for a number of years may be so seriously injured

by one injudicious plowing when the soil was wet that it may be ruined for several years. The injury lies in the modification of its physical texture, not in the lessening of its fertility. A sandy soil may also be seriously impaired for the growing of crops if the organic matter is allowed to be burned out of it. It then becomes leaky and cannot retain moisture sufficient for the best growth of the plants. If these remarks are true, it would be useless to apply commercial fertilizers to land without first putting it in proper physical condition, as this is not only a means of presenting plant foods to the roots of the plants and of distributing uniformly what fertilizers may be applied, but it is also a direct means of conserving moisture and hastening chemical action.

THE SITE OF AN ORCHARD.

The selection of a suitable site for an orchard is a momentous one, being a permanent investment that being once planted cannot be changed. It behooves him who would be a successful raiser of fine fruits to make a careful investigation as to the aspect of the field. Altitude and exposure have considerable bearing and should be given due consideration. So much depends upon the site that it were better to make some sacrifice of convenience than to make the irreperable error of selecting a site that is uncongenial. In the first place, let it be understood that the orchard must be well exposed to the sun and air, they being the great germ destroyers; orchards fully exposed to their influence are much less affected with the many fungous diseases.

The least desirable positions for orchard planting are narrow valleys in a mountainous country traversed by a small stream. Even if such depressions are considerably elevated, they will be found subject to late frosts in the spring and early ones in the fall, especially the former, which are very disastrous to fruit buds that have expanded early in these sheltered nooks. The reason for these apparently choice sites being dangerous is, when the cooling influence of radiation has lowered the temperature and of objects near it, the stratum of air in immediate contact will be chilled, and, becoming heavier will flow down into the most depressed situations and accumulating there will cause a difference of several degrees of temperature. This, when near the freezing point, will be of serious consequence to fruit buds and bloom. They may be perfectly safe at forty degrees, but will be destroyed at thirty degrees or higher in some cases. The ideal site for the orchard is one somewhat above the adjoining land, as it has the advantage of both soil and atmospheric drainage. Of these, the atmospheric drainage is the most important, as we can, in most instances, drain the soil artificially. Flat, low lands, as spoken of in the previous chapter,

are much more subject to frosts than the higher lands. Cold air being heavier than warm air flows from off the higher land and settles in the lower areas, causing in such lands serious late spring and early fall frosts, as well as reducing the temperature in winter. In speaking of elevated lands, it is not necessary that they are rolling, they may be nearly flat if the elevation above the local stream is sufficient. A comparatively slight elevation is often sufficient for atmospheric drainage; if the land below has slope sufficient to allow the cold air to drain away, a few feet being sufficient. But a steeper elevation is always preferable.

The Paragon Fruit Farm lies on a hillside gradually rising to fully one hundred feet at the top. The lower rows are nearly on a level with the creek, passing within one hundred yards, but, to avoid danger of late frosts, I have planted a late blooming variety on this low plane. The first two rows are Rome Beauty, a variety that does not come into bloom until other varieties have finished blooming and dropped their petals. The next two rows are elevated a few feet. This site, apparently, has one of the worst exposures, facing the west and northwest, fully exposed to the severe winds as they sweep down the valley, yet we have never suffered from storm or frost, have never had a failure or an off-year, through other orchards in the vicinity have suffered severely.

The frost line becomes a very important factor in the selection of an orchard site. In some countries we find that its position may be definitely settled within a limited range of elevation. A certain level cannot, of course, be indicated above which there will be absolute immunity from frosts, but we can approximate in certain situations near enough to indicate that certain sites are safe or unsafe. Elevation alone is not an absolute safeguard in any given locality. It might be presumed that the higher the orchard was situated above the water levels, the safer it would be, and the lowest depressions the most unsafe; but it is the relative elevation of the site that renders it more advantageous than others in the same region. There are many orchards that are situated upon moderate hills with a rapid descent of only a few feet into a valley of moderate extent (as the Paragon Fruit Farm, as before cited) that is uninjured when another, at a greater elevation, but in a depression, surrounded by higher lands, will be seriously injured by frosts. In the one case the cold air could flow off rapidly into the adjoining depression; while, in the other, the cold air from the adjoining slopes would collect and accumulate in the basin.

Large bodies of water, as previously mentioned, should receive consideration in selecting a site. It may be asked, how these affect frost? Science tells us,—by their evaporated moisture influence the atmosphere, by enveloping the frozen vegetation in a thick blanket

of fog, enabling it to be thawed out in the dark as it were, by which we avoid the influence of the hot sunshine that would have destroyed the tissues had they been suddenly exposed to it when frozen. The humidity of the atmosphere also modifies the temperature remarkably.

EXPOSURE.

The Aspect: When considering the site for an orchard, the best aspect of the ground becomes a matter of interesting inquiry. To all vegetation, the morning sun is ever a welcome visitor after a night's repose, for plants, as well as animals, rest their functions at night and all nature rejoices at the return of day; hence, an eastern or southern exposure would be indicated as preferable, but, practically, but little difference is experienced. Some planters prefer a southern slope, thinking the fullest exposure is essential; others select a northern aspect, thinking they thereby retard early vegetation in the spring, as well as moderating the heat of the summer sun.

The Paragon Fruit Farm lies on a knoll, sloping off in every direction, which affords us excellent opportunities for judging which is the better. Thus far we have been unable to decide. We find that the same varieties bloom just as early on the northern slope as they do on the southern. Many think that a northern slope retains the frost, the ground remaining frozen a week later than the southern, therefore, the tree must come into bloom later. In theory this may be right, but experience proves it all wrong. We admit the frost will remain and, if covered with mulching, may be two weeks later, yet the tree standing this frozen ground will not be held back proportionally long. In fact, a tree can and does, when the season arrives and the weather is favorable, expand her buds and send out leaves and bloom, if the sun during the greater portion of the day shines upon the top of the tree, even though its roots are embedded in ice; for, in the spring of the year the top acts more or less independently of the roots; the stored-up juices or sap being warmed up by the sun's rays and the warm, genial atmosphere, respond to the call of nature, when excitation takes place in the buds, and they draw upon the reserve forces stored within their cells. This growth continues until the frost is thawed out of the ground and the roots are enabled to send up a fresh supply of raw material to fill the demands of the tree. Ask those having sugar groves if they must wait until the ice is out of the ground before they can tap the tree? They will tell you that a large proportion of the sap runs from the tree while its roots are imbedded in frozen ground and covered with snow. But the berry raiser will tell you, where he has his strawberry patch planted on

the cold side of a hill, he retards his plants by heavy mulching while the ground is frozen, thus getting later fruit. He is, to a certain extent, right, but the conditions are entirely different; he has the entire plant, top, as well as root held, as might be said, in cold storage, and as long as these conditions continue growth cannot begin; and, as time is required for development of bloom and fruit, he can retard their maturity, but not proportionally so, as plants do not make as rapid growth and development in early spring with its varying conditions as it does when the weather has become settled and warm weather is continuous. Berries and vegetables come to maturity a few days earlier when grown on a south-western slope, the long-continued rays of the afternoon sun seem to have a hastening effect in bringing them to maturity. In many parts of the country it is important to consider the exposure to the prevailing winds of the regions. It is not so important in Pennsylvania as it is in the vast prairies of the west where the winds sweep their surfaces, unbroken for hundreds of miles; there shelters or windbreaks of some kind are more or less a necessity. But in a mountainous country, as we have here, windbreaks are unnecessary and often detrimental, and orchards should never be planted in close proximity to large forests. The swaying of the limbs when agitated by the gentle breezes gives them tone and strength to withstand the heavier winds. The other day, while in my peach orchard, a thunderstorm came up, preceded by a terrible windstorm blowing a gale of forty miles an hour. The trees twirled and twisted, bending almost to the ground. I expected to see the trees torn from the ground. After the winds ceased, they again stood proudly erect, without one limb injured in the entire orchard, and but few peaches were whipped off. The swaying motion assists in the healthy circulation of the sap within their cells, and I believe it is as necessary in vegetable life as is exercise in the animal kingdom. The constant agitation of the atmosphere, commingling the warmer with the cooler, has a modifying effect on the temperature, to such an extent as to give immunity from frosts, even on the open prairie. In every instance, therefore, reasonable exposure to changeable atmospheric influences is to be preferred.

Another very important factor and one too often overlooked by the inexperienced beginner in choosing a suitable site, or in planting on a site already owned, is the proper outlet; what kind of a road you will have to travel over; whether it is smooth and solid, or whether it is hilly, stony or sandy, either of which renders it almost impossible to get your products to the markets in a proper condition, for there is nothing so injurious to the appearance, as well as the keeping qualities of fruit as rough handling. Regardless of careful packing, it is almost an impossibility to haul a barrel of fruit over

a rough, stony country road without the fruit giving or settling slightly, and, when a little settling occurs, this makes room for the fruit to move on each other until the entire surface is more or less indented or bruised; this may be so slight as to be imperceptible at first, but, after being held awhile, if the fruit does not decay, it will be observed on peeling that the fruit beneath the skin will have brown blotches.

Then, the distance from the orchard to the railroad station or market is quite an item of expense; whether it will require a team a half a day or an entire day to move a load, or whether it is so close that several trips a day can be made. In the case of one trip, it will cost twelve cents per barrel for team and man; whereas, if the same team can make six trips, it means but two cents per barrel, without taking into consideration the difference in price of the fruit, owing to the condition after a long, rough ride. In planting a peach orchard, convenience to shipping or marketing facilities makes all the difference between profit or loss. I am acquainted with one orchard that is situated on a most excellent site; land well adapted to the production of peaches of the highest quality, and the owner, by good attention, gets good crops of fine fruit, but, unfortunately, he is over ten miles from a railroad station, with the road very rough. The best he can do is to get one load per team per day, and much of the fruit being ripe when picked, being of such a delicate nature, is unsalable at paying prices by the time it reaches market. By the time the season was over, a large proportion of the fruit perished in the orchard, and what was sold did not more than pay transportation charges. The orchard is now being removed. This was clearly a case of going blindly into an enterprise without investigation.

Another matter to be considered, if not near the market, is the railroad facilities. Are they ample, and are they willing to handle your fruit expeditiously and cheaply? It makes all the difference at what time of the day the company puts your fruit into the market. If it reaches there late in the day, unless shipped in refrigerator cars, it almost invariably sells at a loss; but, if you can ship in the evening, being in transit through the night, reaching the market in the early morning, the fruit makes a good appearance, and, striking the market just when wanted, sells at good prices.

Railroad charges cut seriously into the profits. When there are no competing lines their charges are often exorbitant, but when two lines run parallel, they are invariably more liberal. When trolley lines carry freight, peaches can be shipped cheaply and quickly, reaching the retailer or consumer in a couple of hours after leaving the orchard.

PREPARATION OF THE SOIL.

Having selected the site for planting the orchard, the next important matter is to prepare the soil for the reception of the trees, and the more thorough the preparation, the more successful will be the enterprise. When soil and the environments are favorable, good results and fairly remunerative crops are often raised, even under the careless and negligent manner in which ninety-five per cent. of our orchards are conducted. Such being the case, how much more remunerative will the orchard be, where the trees are well set, in properly prepared land, upon a judiciously selected orchard site, and given proper tillage the first few years.

Drainage should be one of the first considerations. If not naturally drained, then artificial drainage must be done, as no fruit tree can thrive or even exist when standing with its roots even partly immersed in water. Drainage is not only to carry away the surplus water that in some seasons prevails in our best lands, but, on account of the more thorough admission of air which is so beneficial to the soil and the roots, mere surface drainage can be done with the plow and should always be done in level lands, especially where the subsoil is very compact. This method is cheap, while thorough underdraining with tiling is expensive; so much so that the average farmer or orchardist thinks he cannot afford it. Yet, thorough draining so quickly and surely pays the cost that its benefits cannot be doubted. The best results follow its use, and he who would reap the best harvest and attain the greatest success, will underdrain his land, if needed. The expense of underdraining is its only objection that we hear urged against it, but it has been repeatedly proven that the outlay insures such an increase in yield that it pays good interest on the investment, except where the natural drainage of the soil, by a porous stratum of rock or gravel, already provide a ready discharge of the surplus water. This is a serious question in a great many sections of the country where commercial orcharding could be made very profitable indeed. During the past winter, while traveling through the northern and northeastern part of the State, I saw thousands of acres of land that are producing nothing, are, in fact, a tax burden to the owners; yet, this land has latitude, altitude, varieties of soil, all in favor of producing the choicest of fruit. I saw thousands of Baldwins, Kings, Northern Spy's, etc., that have withstood the vicissitudes of time, under all kinds of neglect, unfed, unpruned and unsprayed, left a prey to all the fungi and insects that are so prevalent; yet, many of these trees have produced fairly remunerative crops.

What then would be the results if these trees were given proper treatment? They would respond so quickly and produce so bountifully of the choicest of fruit that it would be an incentive to plant

more and larger orchards, and thousands of acres of the now comparatively worthless and barren land would bloom as the rose. Our people are great imitators; where a few succeed, others follow. The germ once planted in favorable soil would develop and spread from county to county, until their gentle rolling hills and even the steeper mountain sides would be covered with thrifty orchards, producing millions of bushels of ruddy-cheeked apples, juicy pears and luscious peaches. Prosperity would take the place of comparative poverty. The magician's wand would sweep over a now discontented, disgruntled people, converting them into industrious, peaceful, contented and happy people.

What is lacking to bring about this great change? Knowledge is wanting; knowledge of the great possibilities that are stored up in these mountain regions, needing but the golden key of knowledge to unlock the rich storehouses of nature that fortunes may roll forth far surpassing those created by the pine and hemlock, by the rich deposit of coal, the oil, the gas and other resources of mineral wealth. I say greater fortunes, because they will be of greater benefit to a greater number of people. The great wealth resulting from Nature's primitive treasures were, and are monopolized by the few, by speculators, at the expense of the many. As the speculators' wealth increased, the citizens' diminished. Why? Because their supply became exhausted and they had no farther source to draw from. They remind me of children standing upon the bank of a turbulent stream; they see Paradise on the other side, but there is no perceptible bridge upon which to cross and they cannot swim. It may be asked if this new resource will not prove just as disastrous; whether it will not be monopolized? It cannot be. The conditions are entirely different. The former could be controlled and held for hundreds of years and grow in value; the latter is a cultivated condition that requires intelligent labor to produce. Let effort cease and production ceases with it. It is produced by the brain and brawn of man. These well directed, the revenues are generous and annual.

Every man or woman owning a piece of suitable land can, with small outlay, plant an acre or two at a time, and by well directed, intelligent care in a very few years be independent of monopolies. But, when larger areas are to be planted, a large proportion of these lands need more or less draining, and this requires money, the one thing that is often very scarce; and, as trees can be planted without drainage, this important part is omitted; many reasoning that if necessary it can be done later. But, if the site be on high land, they reason that it is unnecessary. This reasoning seems plausible, but we find, in many instances, the subsoil is of such a nature that it is almost impervious to water, full of winter springs, being so wet and

spongy for a few months in the spring as to render it very uncongenial for the growth of the trees. To plant on such soil without remedying these defects would be money wasted. If capital is limited, that the necessary amount cannot be spared to put under ground, then cheaper methods may be adopted. But, as a word of warning, I would say if you do not already own the land, but intend purchasing, do not be tempted to buy unsuitable land because it is offered cheap; for what is cheap in the start may be very expensive in the end and too often a total dismal failure. Better pay twice or three times the price for land that is congenial than to accept uncongenial land as a gift. Surface drainage may be done cheaply with the plow and may be done while preparing the soil for planting, and this preparation should never be neglected where the land is at all flat or too retentive of moisture. It has been repeatedly stated that land should be elevated. Such lands are generally somewhat undulating; the flattest fields that should ever be planted present some inequalities of surface. This should be noted before laying off the lands with the plow; calculating to have the furrows cross these inequalities of surface, plowing into lands corresponding with the distance apart the rows are to stand, lapping together the furrows just where the trees are to stand. Should there be danger of water accumulating, this process may be repeated until quite a ridge is thrown up for the trees, raising them beyond all danger, leaving a corresponding depression between the rows, which will serve as a gutter to carry off the excess of surface water. This makes a cheap method of superficial drainage by the judicious plowing of the land. This method should be adopted on all level lands having a stiff clay subsoil. Then, at any time that the owner feels he can afford to lay down a permanent tile drainage, these gutters being at the proper distance between the rows can be deepened and the tile laid without disturbing the roots. Soils having heavy, tenacious subsoils will be greatly benefited by trench plowing. What is here meant by trench plowing or trenching is where the position of two layers of soil are transposed more thoroughly and to a greater depth than is done by simply digging or plowing, in which a limited amount, only a thin layer, of the surface soil is inverted. Trenching with a spade is too expensive for commercial orcharding; it would, therefore, be a waste of time to describe it. Trench plowing is conducted on similar principles, but is done cheaply by using two plows in the same furrow. The first takes off the surface soil and throws it into the deep furrow made by the second plow, which is so constructed as to lift the subsoil and throw it high up over the furrow slice laid by the first and, at the same time, leaving a deep furrow behind it to receive the next cut of surface soil. The two layers are thus inverted and reversed at the

same time. The whole surface is finely comminuted with a proper plow and reduced to a thorough seed bed. This work is done with the double plow. The subsoil plow has more or less taken the place of the trench plow in orcharding.

To prepare the soil by subsoiling, a good, strong mould-board plow is used to invert the surface soil to a good depth. This is followed by a subsoil plow which does not invert, but merely lifts and crumbles the stiff, hard subsoil beneath. The depth to which this plow works depends upon the strength of the plow, the power of the team and the character of the subsoil. Where the subsoil is not too tenacious or hard the subsoiling is left off; in a great many soils the benefit to be derived would not pay for the extra labor. The preparation again depends largely upon the strength and condition of the soil, the amount of fertility it contains.

Trees are gross feeders, and to have them thrive and produce remunerative crops you must have an ample supply of such elements as are necessary for the best growth of the tree and fruit. The roots of a fully developed tree extend far and deep. It is generally conceded that the roots extend over as large an area as a circle made by the height of the tree. I believe, in many instances, it far exceeds this; but it matters little what their length if the food is not in the soil within their reach and in an available form, the tree quickly hangs out the signal of distress, both by lack of growth of its twigs and the color of its foliage. It is, therefore, policy for the intending orchardist to know the condition of his soil; its bankable resources (for it can be likened to a bank account—a draft upon a bank without a deposit to the maker's credit is worthless), as well as its mechanical condition. If the soil has been under cultivation and has been producing fifty bushels and upward of shelled corn to twenty bushels of wheat, one hundred and fifty to three hundred bushels of potatoes, or one and a half to two tons of hay per acre, then it is in fair condition as relates to fertility and may safely be planted to fruit with a fair assurance of thrifty growth of the trees. But if the yield is much below, it would be better to apply such fertilizers as may be needed before the trees are planted, as this is the most favorable time. If an apple orchard is to be planted and you are anxious to plant without delay, a good coat of well-rotted stable manure may be spread evenly over the surface and thoroughly incorporated; but it would be better policy to plant some cultivated crop, using an abundance of fertilizers and plant in the following fall or spring.

But if the orchard is to be planted to peach, use nitrogenous fertilizers sparingly if you wish for longevity and productiveness; but you need not hesitate in applying an abundance of potash and phosphoric acid. Lime and the alkalies are always safe and useful

additions and, in connection with the clovers, cow peas, vetches or any legumes, form the very best foundation upon which to build the orchard. The clovers have the advantage over all others of our growing crops, its long roots penetrating so deeply down into the subsoil bringing up from below the hidden treasures which are digested by the plants, modified by chemical changes, forming new combinations which will be used by succeeding crops. If the plot is in clover, fifty or sixty bushels of lime per acre will be valuable, increasing the growth of the clover, and will exert a favorable influence upon the physical condition of the soil, particularly adapting it to tree growth. The alkalies may be applied in several forms. If wood ashes can be obtained, it is one of the most valuable sources of the alkali fertilizers, furnishing the potash in the form of a carbonate and the phosphoric acid and lime in their most available form.

In preparing the soil, where subsoiling is not required, use a large plow capable of turning and breaking up a large, deep furrow, never taking a furrow slice more than an inch or two larger than the share of the plow will cut so that the plowing will be complete. It should be plowed ten or twelve inches deep, bringing up a part of the subsoil and turning the richer surface soil down. For cultivated crops this would not put the soil in the best condition, but now you are laying the permanent foundation for the orchard and you wish to get humus and available plant food where the roots can get it, keeping the roots deeper instead of coming to the surface in search of what they need. If you do turn up a few inches of poor subsoil you have it in a position where you can soon make it fertile, but as long as it remains ten or twelve inches beneath the surface unbroken you can never improve its condition. And always bear in mind that the thrift and productiveness of the orchard depend as much upon the depth and condition of its bed and the amount of fertility it contains, as they do upon any of the other essentials. It is better to break up the soil early in the fall. Some will claim that there will be a loss of fertility by lying fallow without any growing crop over winter. This is correct, but the gain in the mechanical condition by the exposure of the subsoil that never before saw the light of day will be so great that it will more than counterbalance the little fertility lost, and when the harrow is placed upon it in the spring you will first notice how well nature has assisted you. The action of the great forces, heat and cold, freezing and thawing, air and sunshine, with an abundance of moisture, has so broken up, divided and subdivided the different particles making up the whole that, at the touch of the harrow and the friction it exerts, it falls away as friable and mellow as ashes, which, in turn, will soon be in condition to support vegetable life. After this has been sufficient-

ly harrowed and reharrowed to give it the necessary compactness to favor capillarity and get the surface smooth and even, it should be rolled to render it smoother and more convenient for marking out for planting.

LAYING OUT OF THE ORCHARD.

Many methods are adopted in laying out orchards, depending upon the lay of the land or the fancy of the planter. Very uneven land is much more difficult to lay out in straight lines than a field that is practically level, that sighting poles can be seen from end to end and side to side. It also depends a great deal upon the whims or pride of the planter. It he wishes entirely straight rows that will sight true crosswise and diagonally, it requires much more care in setting than if this is a secondary matter. If correct position is desired, it will be necessary, if the plantation is large, to use a steel tape and compass, have the stakes set with precision, and even then crooks are apt to creep in, for it is practically impossible to remove the stake, dig the hole and set the tree in the exact position occupied by the stake. The only method by which this can be done is by having a stake set wherever a tree is to be set, then have

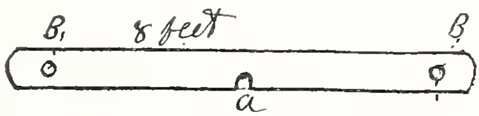


Fig. 15. Planting board, 8 ft. long B. B. Pin holes, 7 feet apart. A socket for tree half way between.

a board about six inches wide and eight feet long, as shown in Fig. 15. Cut a notch in one side at the middle, just about large enough for the stem of the tree, bore a hole through each end exactly the same distance from the middle notch. Then, whenever a tree is to be planted, place the board on the ground with the notch around the stake and stick two other pegs through the holes in the end, remove the board, leaving the two pins remain, dig the hole, replace the board and set the tree with the stem in notch. Proceed in this way until the entire orchard is set and the results must be straight rows no matter in what direction the board is placed or how many sets of planters are at work.

One principal feature in laying out an orchard is to leave ample room for a driveway and for turning the team while cultivating. Have this driveway entirely around the field. If it is in an apple orchard, let this be not less than thirty feet from the fence. The most convenient line to use for getting distances is to have a number twelve wire long enough to reach across the field. If not more than twelve or fifteen acres, have the ends fastened securely

to a suitable handle. Beginning at one end of this wire, wrap two or three coils of small annealed wire around it and solder fast, and at whatever distance you decide to plant, solder your wire. When this is completed, tie a small piece of red flannel around the piece of soldered wire. This will be plainly seen. Then have two men, one at each end, to stretch this wire tight along one side at the proper place. Have a third man or boy, with a bundle of stakes, stick one at each place marked on the wire. When this side is complete stretch the wire at right angles, starting with the first mark at the end stake of the first line, with the line stretched tight at perfect right angles and have the boy stick pins this entire length. Continue this around the field. To get your lines at right angles, take the two last stakes of the first line measured, tie a piece of cord to the second stake, stretch it beyond the end stake and tie it to another stake driven in such a position that the line will just touch the outside of the last stake. Then measure from a mark just clearing the corner stake, back toward the second stake eight feet, and make a pencil mark. Drive another stake at right angles from the first line about two feet back of the end stake; tie a string to this and stretch it at right angles across the first line with this line just touching the corner stake, stretch tight, drive a pin and fasten, then measure along this line from the first line, six feet. Then use your ten-foot pole, place it diagonally across from line to line, with the corners nearest the lines just touching the marks made. If it is correct, the square is perfect. If the last line is too far out, the pole will fall short and the last stake must be moved in until the pole just fits. Should the pole overlap, then the stake must be moved outward. Be sure you measure the distance along the line after each time the stake is moved, as the line might become stretched tighter or looser; when complete, which only takes a moment to do, then stretch your wire along these two stakes, just touching the outside, and again stick stakes, as previously mentioned. This is shown in Fig. 16.

When the field is thus outlined, with the same wire stretched from end to end, always starting with the first mark at a stake, the entire field can be rapidly and accurately laid out with a stake in position for each tree.

In laying out rows for tree planting at the Paragon Fruit Farm, the plow is used for marking out and making trenches for planting. After the field is outlined, we set up sight poles and with a light plow draw furrows crosswise, from which we plant, making these furrows but three or four inches deep. Then we hook in a large plow. We use the No. 1 steel beam plow; with this we draw a deep furrow with the land side sighting on the stake. Turn back and draw another furrow a little deeper. This opens a great, long,

broad, deep furrow, or trench, fifteen inches or more deep with the surface soil and subsoil thoroughly mixed together, for, at every passage of the plow, a portion of the soil rolls back, and when the furrow is complete it is in the very best mechanical condition possible. Bone meal is then strewn at the rate of one thousand pounds per acre the full width of the furrow or trench.

In this trench the trees are planted as follows: The trees are pruned in advance, as given under the head of pruning, are put into a section of a barrel, which is placed on a sled partly filled with a puddle of clay and water. A horse is attached to the sled that it may be moved along as we plant. One man, with the team, opens the trench; the bone meal is strewn and we are ready for rapid and efficient planting. Three men are necessary; one man to place and sight the trees and two men with shovels. As soon as the tree

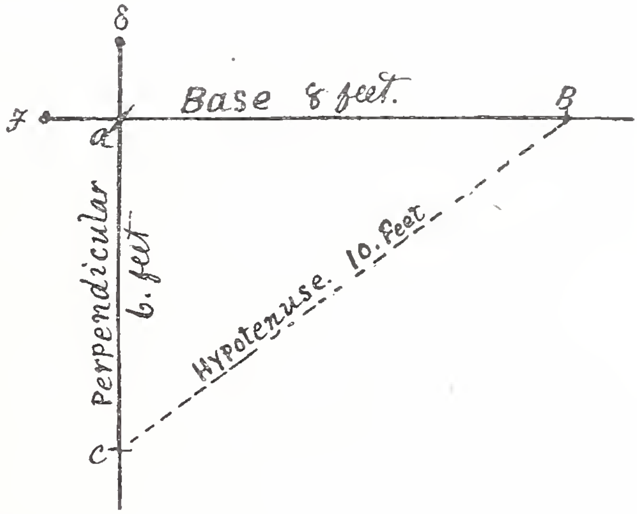


Fig. 16. To square an orchard. A is the corner where the first tree is set. C and E are line stakes. B and F are also line stakes. Measurements are from A to C and from A to B.

is placed at the intersection, where the light furrow crosses the trench, the two men begin shoveling in the ground, and the man holding the tree tramps it firmly around and on the roots, using both feet and his entire weight. If the soil is in proper condition, he need not fear getting it too tight. It is only when the soil is wet that there is danger of getting hard, and in that condition we never plant. If, on picking up a handful of soil and squeezing it into a ball, it readily crumbles when dropped on the ground, it is right. As soon as the roots are thus covered and the tree stands firm, we pass on to the next space and set another tree in the same way. Never finish planting the trees by hand; by the time the end of the row is reached, another trench is ready, and the team is waiting to finish planting the row, which he does by throwing in

two moderate depth furrows from each side. He then opens another trench; thus, team and men are kept busy until the entire tract is planted. The team is then hooked to a spring tooth harrow and the orchard is harrowed crosswise, thus closing the open furrows. The ground is then harrowed both ways with a section spike harrow, which leaves it as smooth as though raked with a garden rake. The trees are planted in the very best condition possible and at less than one-fourth the cost of hand planting. I am frequently asked how large I dig holes for planting trees. That depends upon the size of the plot to be planted; if it is ten acres the hole is of the same dimensions, as the whole field is plowed to the uniform depth to which the trees are planted.

The question is often put, while lecturing at Farmers' Institutes, how I would plant trees where the ground was too steep and too stony to plow and get the soil in condition. I would then do the next best thing I could. After marking the land as near right angles as the surroundings permitted, I would dig large holes not less than two and a half feet to three feet in diameter and fifteen to eighteen inches deep. In digging, I would put the turf and surface soil on one side and the subsoil on the other, thus keeping them separate. I would then put the turf in the bottom around the hole and sufficient of the good surface soil to fill the hole high enough that when the tree is set it will stand about one inch deeper in the ground than it stood in the nursery row.

When the tree is put in place, cover the roots with the top soil, settling the ground in and about the roots by slightly shaking the tree and packing the ground as when planting by the plow. After these trees are planted, as the soil cannot be cultivated, I would mulch the trees heavily with anything I had, straw, long manure, spoiled hay, grass, weeds, and, if nothing better was at hand or could not be obtained, and stone were plentiful, I would not hesitate to use them for mulching, as they will aid in keeping the ground cool and moist. If you doubt the benefit to be obtained from stone, place a heap of stone on a poor piece of ground, leave them lie a year or two, remove the stone, break up the soil and plant some growing crop, and note the difference in growth between the spot formerly mulched with the stone and the surrounding soil. Not that the stone has furnished any fertility that would be observable, but they have created a condition that was favorable for the development of bacteria that have the power to abstract nitrogen from the air and give it up to living plants.

DISTANCE TO PLANT.

This depends upon varieties, some growing to a very large size, while others never make very large trees; then, soil has consider-

able to do with the size of the tree. Rich, fertile soils will grow larger trees than poor soils. Tillage is likewise a factor that plays no small part in the development and size of trees. All these should be taken into consideration in deciding on distance, but it is better to be on the safe side and give ample room for the tops and roots to spread than to have your trees crowded, with no room to grow except toward the heavens. Then, the apple and pear require more room than the peach, plum and cherry.

Many think that thirty feet by thirty feet is ample room for the apple. It may be with some varieties, on some soils, under the starvation plan, but to get best results it is too close. In 1879, 1880 and 1881 I set out an apple orchard at these distances, but soon found I had made a mistake. Under my method of liberal feeding and cultivation they soon began to crowd. I had trees that lapped branches in eleven years, and although the orchard proves profitable it is too much crowded for all purposes. In 1896 I set out another orchard. The Paragon Fruit Farm apple trees were set in about fifteen acres, at thirty-five by thirty-five feet each way. Between these in one portion of the orchard, peach trees were set, three peach to every apple tree, bringing the stand to seventeen and one-half feet each way. Another portion had quick-bearing varieties of apples set between as fillers.

Now for results. The soil is naturally good fruit soil. I do not believe that there is a better fruit belt in the State of Pennsylvania: if elsewhere, I have never seen it. Under the generous treatment given this orchard they grew rapidly, the apple averaging one inch stem diameter increase annually. Many of the apples began bearing at the third and fourth year from planting. The peach even exceeded this, and at two and one-half years averaged one basket (of sixteen quarts) per tree, with a constant increase in growth and productiveness, without any off-year, until they were in their eighth year, giving that year the enormous crop of from fifteen to twenty-four baskets per tree. But the trees had now attained such dimension that they seriously encroached on the apple trees. Prof. Surface and I measured these trees and found their top diameter was from twenty-five to thirty-three feet, the branches so intermingling with the branches of the apple that it became a matter of a removal of one or the other, or permanently ruin both.

As this orchard was planted for an apple orchard, I decided to carry out my original design and removed the peach, although they were in perfect health with every prospect of bearing succeeding profitable crops. This was one of the severest tests I was ever put to. It was certainly a serious matter to cut out trees that had in this last crop given me from fifteen to twenty-four dollars income per tree, and I never wish to be placed in the same position again.

When I am questioned relative to planting peach trees between apple trees for fillers, I invariably advise planting each alone, unless he feels assured that he will have the courage to cut out such trees that are bringing incomes almost beyond belief. There is not one man of of every fifty that has the courage to do so. But I have never regretted it. I removed them before any permanent harm was done to the apple, and they are now fine, large trees, models of beauty, symmetrical in outline, with heads spreading from twenty to twenty-five feet in diameter, and have been producing increased annual crops for several years. Many of them produced as much as ten bushels per tree last year, and this year they are so heavily laden that we are removing fully half of the fruit from many varieties, to prevent the branches from breaking. Were these trees not trained for strength by the method of pruning they have received, they could not possibly bear their loads. These trees are now eleven years old. By the time they are twenty years old the limbs will be too close for best results and conveniences in spraying. In future plantings I shall place apple trees forty feet apart. My pear trees are planted twenty by thirty feet apart. At present they have sufficient room for bearing, but are too close for convenience in spraying. Future planting will be not less than twenty-five by thirty. They have been producing from two to four bushels per tree for the past two years and must be very much thinned, removing from one-half to two-thirds of the fruit.

My peach orchard is planted fifteen by fifteen feet, with a thirty-foot driveway every six rows and a thirty-foot driveway around the entire field. Here we again find the same trouble; should be twenty to twenty-five feet apart. This peach orchard will be described under the heading of peach culture.

Fig. 17 shows diagram of peach orchard.

It will be noted here that the two end blocks at each end of this orchard has seven rows of fourteen trees each, or ninety-eight trees to the block, while the intermediate blocks have only six rows of fourteen trees each, or eighty-four trees in the block. The only object in this was to occupy the ground in the field, the size of which was 480 feet by 690 feet, containing a trifle more than seven and one-sixth acres. The driveways, after allowing the proportion occupied by the trees, take up over one and three-fourth acres, leaving less than five and one-half acres actually occupied by trees. This large area taken for drives may be considered a waste of ground; that this space could also be occupied by trees, but I can assure you it is ground well utilized.

The outside thirty feet is required for turning when harrowing, and as the harrow used is fourteen and one-half feet broad, this space is none too large to turn and enter the next space. Then, the

PARAGON FRUIT FARM, BOYERTOWN, PA.

Plot of Six Acres of Peaches.

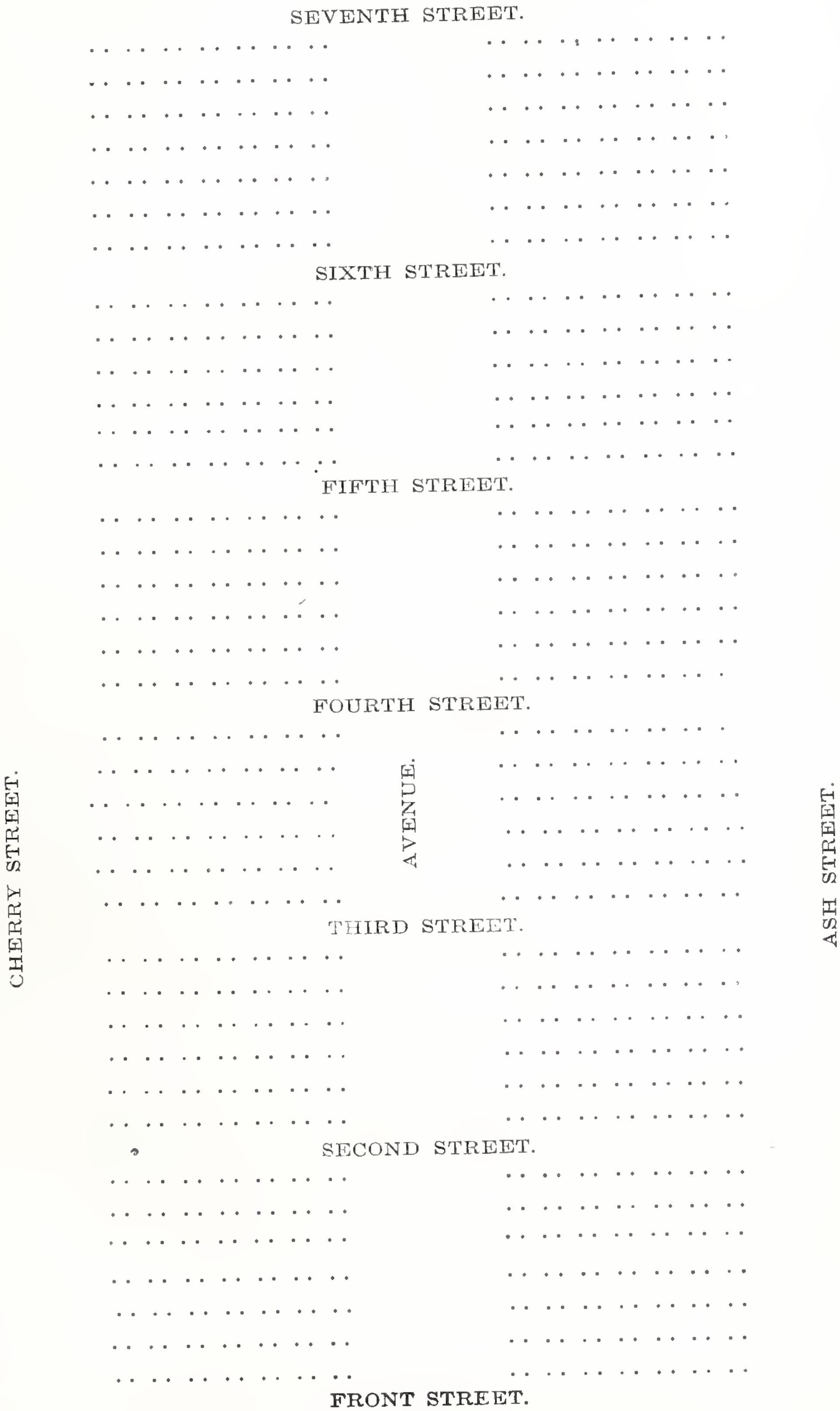


Fig. 17.

intermediate spaces or driveways are for driving through to haul out peaches, as the trees on the blocks are too close to permit the team passing through with a wagon, but, by looking at the diagram, it will be noticed that the fruit must only be carried two or three spaces to the driveway, to be loaded on the wagon. We have the pickers place their filled baskets in the shade of the outside row.

Whatever changes will be made in the future plantings, will not be the cutting out of the driveways, but increasing the distance between the trees. The benefit of a greater distance is apparent in this orchard. The trees in the outside rows of these blocks, where they have the benefit of the thirty-foot driveway, are larger, the foliage is a richer green, the fruit is larger and more highly colored. This is readily accounted for by the roots having a larger area upon which to feed. They have more air and sunshine. All of these are great factors in producing healthy trees and fine fruit. I believe a block of several acres of peach trees planted twenty-five or thirty feet each way, would produce more and better fruit than when planted closer, and the convenience in spraying, pruning, cultivating the trees and harvesting the fruit would amply pay by the saving of time and by better work being done.

Fig. 18 represents the plan upon which a part of the apple trees in the Paragon orchards are planted. This plot also a broad driveway of thirty-five feet around it, giving ample room to turn.

This part of the orchard is planted in the rectangular style, with the permanent trees thirty-five feet apart each way, as shown in the upper part of the diagram. When this orchard was planted, ground was considered too valuable to be wasted. Every foot was to be utilized in the production of fruit, therefore, the permanent trees were set at what was considered the proper distance, then the section between was planted with peach and other varieties of apples that come into bearing young. These trees were to be removed before they seriously injured the permanent trees. Figs. 18 and 19 show the fillers represented by "o" and "x." By past experience, I see that this is not the best way to build up an orchard, and in my own experience I found these fillers (except peach) cost me more than they returned. They all grew so rapidly they soon crowded each other in, root and top. Then the variety that was so highly extolled by practical-fruit men (the Missouri pippin) as being an early and abundant bearer of choice fruit; to my sorrow I planted two hundred of these. Then, the Shackleford was recommended as another stepping stone to fortune. I took the bait nicely and planted two hundred of these. As to early bearing and productiveness, they certainly did their part in making the recommendation good, and, as to beauty, the Missouri pippin was, indeed, fair to look upon. If the Ben Davis is a gay deceiver, then, surely,

the Missouri pippin is a worthy mate, while the Shackleford proved equally worthless, without even beauty to recommend it, being coarse-grained, insipid, worthless. I never saw the man, or even the small boy, that had the courage to put an entire apple of either variety into his stomach. As an apple for home consumption, they were a failure, and as a commercial variety, I did not have rubber enough in my make-up to give sufficient elasticity to my conscience to sell them. Therefore, I cut their acquaintance by eradicating them, root and branch. I often wonder what is the physical make-up of a man who can really enjoy eating a Ben Davis, Missouri pippin and kindred varieties of apples, and what their sensations would be if they should accidentally get hold of a Smokehouse or a Stayman Winesap, as we grow them in the Paragon orchards. They would surely think they had discovered the variety with which fair Eve tempted poor Adam, and that the varieties they were accustomed to were those the Lord gave to Adam and Eve that they might sweat while endeavoring to penetrate their fair, but leathery hides, and masticate the wood-like structure with sorrow.

Fig. 18.—Rectangular plan adopted at the Paragon Fruit Farm. Thirty-five permanent trees to the acre.

* Represents permanent trees. o Represents apple fillers. x Represents peach fillers.

*	x	*	x	*	x	*	x	*	x	*	x	*
x	o	x	o	x	o	x	o	x	o	x	o	x
*	x	*	x	*	x	*	x	*	x	*	x	*
x	o	x	o	x	o	x	o	x	o	x	o	x
*	x	*	x	*	x	*	x	*	x	*	x	*
x	o	x	o	x	o	x	o	x	o	x	o	x
*	x	*	x	*	x	*	x	*	x	*	x	*
x	o	x	o	x	o	x	o	x	o	x	o	x
*	x	*	x	*	x	*	x	*	x	*	x	*

Fig. 19. Peach removed after eight years. The five upper rows show the permanent trees and fillers. The lower rows show the permanent orchard.

*   *   *   *   *   *   *

o   o   o   o   o   o

*   *   *   *   *   *   *

o   o   o   o   o   o

*   *   *   *   *   *   *

*   *   *   *   *   *   *

*   *   *   *   *   *   *

Fig. 20.—Alternate plan adopted on part of Paragon orchard. Forty-nine permanent trees to the acre and forty-nine fillers.

* Represents permanent trees and x fillers.

* x * x * x * x * x * x * x

x * x * x * x * x * x * x *

* x * x * x * x * x * x * x

x * x * x * x * x * x * x *

* x * x * x * x * x * x * x

x * x * x * x * x * x * x *

* x * x * x * x * x * x * x

Fig. 21.—Shows orchard after fillers are removed.

```
*     *     *     *     *     *     *
    *     *     *     *     *     *     *
*     *     *     *     *     *     *
    *     *     *     *     *     *     *
*     *     *     *     *     *     *
    *     *     *     *     *     *     *
*     *     *     *     *     *     *
```

Fig. 22.—Shows an orchard planted thirty-five by forty feet, with a row of peach between the forty-foot space.

*Represents permanent trees and x the peach.

```
*     *     *     *     *     *     *
x  x  x  x  x  x  x  x  x  x  x  x  x
*     *     *     *     *     *     *
x  x  x  x  x  x  x  x  x  x  x  x  x
*     *     *     *     *     *     *
x  x  x  x  x  x  x  x  x  x  x  x  x
*     *     *     *     *     *     *
x  x  x  x  x  x  x  x  x  x  x  x  x
```

This gives thirty-one permanent trees and sixty-two peach trees to the acre.

The peach trees did better, and inside of eight years, by which time they had to be removed for lack of room, they had paid for the planting and growing of the entire orchard and good interest beside.

Fig. 20 shows another portion of the apple orchard planted on the alternate plan. This plan is preferred by many, thinking that more trees can be planted to the acre without crowding. This is about like telling you that two things can occupy the same place at the same time; more hallucination. An acre of ground contains 43,560 square feet of ground, and trees planted thirty-five feet by thirty-five feet each way gives thirty-five feet to the acre, allowing 1,225 feet to each tree. Now, when we plant, as shown in diagram, Fig. 21, where the rows are thirty-five feet one way by twenty-five feet the other, but with trees set in such positions that the tree in the second row is not beneath the one in No. 1, but diagonal to it, what have we? Have we gained anything? Have we gotten something from nothing? Not at all; we have merely transposed forms. We have compressed the two corners of a square and converted it into a diamond, and set it so that the transposed side becomes the hypotenuse, which measures thirty feet. This method gives us forty-nine trees to the acre; surely a gain in number, but when we figure the area of this diamond we find it contains but 900 square feet, instead of 1,225 feet, as in planting thirty-five by thirty-five feet. Practically the same as if we had planted in the rectangular style, thirty by thirty feet. As seen in this figure, there is a twenty-five feet driveway around the plot. This plot is laid out by running the first line twenty-five feet from the fence, then commencing to measure from the fence running at right angles, measure twenty feet and drive a stake; continue along this line, and every thirty feet put a stake. Now for the second row; this runs parallel with the first one, but only twenty-five feet from it; but, instead of putting the stake for the tree twenty-five feet from the fence, as in row No. 1, you put it forty-two and a half feet. Continue along this line and put a stake every thirty-five feet. Row No. 3 again drops back and has its first stake twenty feet from the fence.

If desired, in either of these plans, three fillers can be used to every permanent tree, thus placing each tree seventeen and one-half feet from its neighbor. This plan I used in part of my plantings, but the trees quickly crowd and must be removed. (Shown in Fig. 20.)

Another plan, and a good one, if the planter can resist the temptation of letting the trees stand too long, is to lay out the plot for permanent trees, thirty-five feet one way and forty feet the other way, then midway between these trees that are forty feet apart, plant peach, or, if you wish, apple. Plant such varieties as Yellow Transparent, Wealthy Jonathan, or any other quick bearer. (See Fig. 22.)

This method gives ninety-three trees to the acre, and when fillers are out, leaves thirty-one trees per acre for permanent orchard. This is a good distance for large-growing varieties and will not be too far apart at thirty years of age.

That the distance at which trees are planted has considerable influence on the productiveness of the trees is shown in some reports given by G. F. Warren, of the Cornell Station, New York. Among other things reported, is a four years' average on trees planted at different distances.

Trees planted thirty by thirty-five feet average one hundred and eighty-six bushels per acre.

Trees planted thirty-five by thirty-five feet averaged two hundred and twenty-two bushels per acre.

Trees planted forty by forty-five feet averaged two hundred and twenty-nine bushels per acre.

Ample distance invariably favors productiveness.

PRUNING.

One of the most important problems confronting the horticulturist is that of pruning. It is one of those subjects that can have no fixed rules laid down for the guidance of the beginner. He must be a close, observing student of nature; he must be a lover of nature; he must have an eye for beauty and symmetry; he must have culture, intellect and judgment above the ordinary; he must have skillful training that he can understand and follow Nature's teachings. She guards her secrets well, and only those who, by close observation and deep thought penetrate beneath the surface, are permitted to see and understand her intricate workings. There are so many things to be considered. The development of the tree begins when the germ responds to the influence of the necessary elements, heat, moisture and air.

From the time the sprout reaches the surface it requires the care and attention of the owner; it is fed, cultivated and pruned through all its successive stages of growth to maturity. It may, therefore, be reasonably supposed that no one is capable of training a tree who is ignorant of the nature and habits of tree life and tree growth; he must know the object for which he prunes. Merely to cut off the top of the young trees, or the terminals of the limbs, is not pruning. To obtain beneficial results, he must know when to prune; and the next important step is to know how to prune, and this knowledge can only be attained by carefully studying the structure of the tree. If the work is not properly done more harm than good will result. We see instances of this as we travel by rail or on wheel through the country. Many orchards have never been pruned from the time of planting; their tops are so completely choked with

a network of brush and dead limbs as to entirely exclude the air and sunshine. The opposite to this is the orchard that has had all the lower limbs cut off, forming great, high, unsightly trunks, from six to eight feet high, that the hired man can plow without having his hat stripped off by a low, hanging limb. A perfect orchard is, indeed, a rarity; the same remark applies to the nursery. The trees are grown for the market in the shortest time possible, receiving very little attention as to their form. These trees are frequently sold to a man with no knowledge as to their requirements, so he gives them still less attention, with the result of long, one-sided, distorted trees, and a disappointed man.

Many writers advocate that pruning is unnecessary, but this has been carried in practice to such an extent that more than three-fourths of our bearing fruit trees in the country at the present time are prefect masses of wood, unable to bear a respectable crop of well-matured and well-colored fruit. Look at the difference between the above and a well-managed, well-pruned orchard, either cultivated or heavily mulched, with its open head, the fruit exposed to the air and sunshine, yet carrying an abundance of rich, healthy, clean foliage for the preparation of sufficient food to mature a full crop of not only large and perfect fruit, but, with their skins brilliant and smooth, with their beautiful coloring, rich and delicate bloom. This should be an object lesson; it should teach us the value of pruning. But this is only one of the objects. We prune to reduce vigor in one part and to favor growth in a weaker part. We prune back the head if it is growing too rapidly, thus encouraging the spread of the tree. We prune back a branch to produce ramifications, filling vacant spaces, changing and modifying the contour of the tree. We prune to bring a tree into early and profitable bearing. If bearing heavily at the expense of the vitality of the tree, then we prune to produce wood; we prune both roots and tops. We prune in the growing season and while trees are dormant, so we prune all parts of the tree at all seasons and to produce opposite results. It will be well to treat several branches of pruning under separate heads.

1. Pruning to direct the growth of one part of the tree to another. Beyond doubt, a large majority of our fruit growers have little, if any, knowledge of the requirements of a young tree and no practical experience in the business, and so have everything to learn, and there is no part of the orchard management of more importance than to start the young tree just right. On this depends not only the future usefulness of the orchard; but, in many instances, large numbers of young trees fail to live through the first season, for the simple reason that the trees were not properly started. I am frequently asked the cause of the dying of newly set trees, and on

visiting the orchard I found that the trees were planted just as they had been received from the nursery. In addition to this, they are frequently left stand or lie for hours with their roots exposed to sun and winds. But, with the best of care, it is a difficult matter for the young tree, with its multilated roots, those that are of most service in furnishing water and food, to establish itself and support a vigorous or overgrown top. It is not generally taken into consideration that when a tree is taken from the nursery for transplanting, fully three-fourths of the root system is left in the ground, thus destroying the equilibrium between the roots and the top. To again restore the proper balance, an equal proportion of the top should be removed. Practically all the elements that nourish and build up the tree are taken from the soil in liquid form. This material is carried in the cell sap, mostly through the outer sap wood to the leaves. Here the crude food is changed by the influence of the sunlight and the green substance in the leaves to a form that can be readily assimilated by the plant. This will illustrate how important the roots are to the plant or tree. Much of this elaborated sap may be stored up in the cells, especially in the fall, to be drawn upon any time the roots fail to supply the requisite amount. If, in being transplanted, the nursery tree is deprived of the larger proportion of its roots, new roots must, to a large extent, be restored before much new food can be supplied; in the meantime, the leaves begin to push out and the reserve food and moisture may all be consumed before the root system is in condition to furnish more. Is it any wonder then that the failure to cut back the tops of newly planted trees is attended with such disastrous results and so many trees die. Before planting, all torn and bruised roots should be cut smoothly off to the proper length. What is the proper length? Opinions differ on this question. Some advocate leaving as much of the root as possible, claiming it is better able to take care of the top; others advocate cutting off all roots to three or five inches. By the Stringfellow method, all roots are cut off close to the main root, leaving mere stubs, which are planted by making a hole with a crowbar and inserting the stub, and closing the hole by pressing the ground tightly around the tree.

To ascertain which is the best method, a series of experiments were conducted at Newark, Delaware, on heavy, but well-drained clay loam, with a heavy subsoil eight to ten inches beneath the surface. Another trial was conducted at Seaford, Delaware, in a well-drained sandy loam, with a stiff subsoil two feet beneath the surface. At each place the following trees were planted, fifty-four trees each of two-year apple, two-year pear, one-year peach and one-year plum. Of these, eighteen each were stub-pruned, eighteen of each were pruned to three inchs and eighteen were pruned to eight

inches. The results were as follows: At Newark, eighty-two and one-half per cent. of the trees pruned to eight inches lived, ninety-seven per cent. of those pruned to three inches lived and sixty-two and one-half per cent. of those pruned to stubs lived. At Seaford ninety-four per cent. of the trees pruned to eight inches lived, one hundred per cent. of those pruned to three inches lived and eighty per cent. of those stub-pruned trees lived. But this did not complete the story. Of those at Newark, eighty-two per cent. pruned to eight-inch roots gave first-class trees, ninety-two per cent. pruned to three inch roots gave first-class trees, and twenty-two per cent. pruned to stubs gave first-class trees. At Seaford, those trees pruned to eight-inch roots gave eighty-six per cent. first-class trees, the three-inch roots gave ninety-six per cent., and the stub-pruned trees gave fifty-one per cent. first-class trees. In summing up the two series of experiments, it is plainly shown that the best results were, in every instance, obtained from trees having their roots pruned to three inches, the next best results were obtained from trees with roots pruned to eight inches, while those trees having their roots cut short by the Stringfellow method, gave very poor and unsatisfactory results.

The question is frequently referred to me at Farmers' Institutes and horticultural meetings as to my opinion of the Stringfellow method of pruning, and the question is generally put by one not particularly in love with work and this method is very alluring; all one needs to do is to get a good, sharp, heavy crowbar, jab a hole in the ground, insert the tree, close the hole, and the job is done; no hole to dig, no large hole to close, no dirt to handle. This question can best be answered as follows: In a moist soil, in a moist climate, in a moist year, fair results may be obtained. In stiff, heavy soils, in dry, gravelly soils, in a dry climate, in a dry season, the results are sure to be a total failure.

This system is all right in certain localities. In Texas where Mr. Stringfellow has had his success, or in Florida, or almost any of the southern tier of states, this method can be successfully carried out. In those states you can take cuttings ten or twelve inches in length of last season's growth of the Oriental pears, such as the Chinese sand pear, the Keiffer, the Lecomte and others, the Marrianna plum and many other varieties of trees, stick them in the soil, leaving but one or two buds exposed, and pack the ground tight, and ninety-five per cent. will grow; but try the same experiment in Pennsylvania and you will be fortunate if you get five per cent. to grow. In those states, the majority of the Oriental varieties are raised on their own roots from cuttings, and they are preferable to being top-worked on French seedlings.

When shall we begin pruning? This a question of grave import, and every beginner should bear in mind that the first few years training of a young tree determines largely its shape and the future usefulness of the tree. When a young tree starts from the seed, bud or scion, in the nursery row, or in a fence corner, it sends out limbs along its stem, and these aid in giving strength and the natural taper to the trunk. If these are removed too early, keeping the young stem clean, all the growth is upward, the tree becoming long and slender, with a heavy bush at the top; the symmetry of the tree is destroyed, the top becomes heavier than the spindly, weak stock can support, and the results are deformed trees which, when they come into the hands of the farmer or uninformed planter, he puts stakes besides them to hold them up. The experienced nurseryman never makes this mistake. Trees, coming from a first-class nursery never need staking, it is only those improperly grown. The short time a tree is in the nursery is insufficient to give it the proper form. The real training comes under the hands of the farmer or fruit grower, and, taking this into consideration, knowing that the average planter has no practical knowledge whatever, it is little wonder that we see so many ill-formed and unprofitable orchards. The success of an orchard depends largely upon the practical knowledge and skill of the planter. If he has no knowledge of the nature, habits and form of growth of the different kinds or variety of fruits, how can he give intelligent pruning? And, if improperly pruned in early life, all the future skill he may attain can never fully overcome the evils of early mistakes.

Form of Tree.—In earlier times the tree was left to form its head according to surroundings and the habits of the variety. The business of orcharding was not old enough to have developed systems of pruning. The conditions of those times were such that fair fruit was produced with little care and no skill on the part of the grower. There was little incentive for the development of the finer art of pruning; there was no competition; the tastes of the people were not cultivated; there were few insects and diseases to call for any special methods or systems of culture.

The commercial orchardist must have a certain ideal; he must adopt some system of training. The two most commonly adopted are known as the pyramidal and the vase forms. The former preserves a leader which forms a central shaft from which limbs branch out in every direction. This form has several advantages; first, it gives more bearing surface,—one great advantage is there are no forks. In a pyramidal tree no limb starts out just opposite the other; each is independent, and each limb has a collar or band surrounding it, forming a shoulder next to the tree, adding great strength and rendering it impossible to split under a heavy load.

It may break at some distance from the leader, but will never injure the central shaft, save by leaving a vacant space.

The vase form has no leader, but the top is formed by three or four or five limbs starting from a given height; each of these forms a tree of its own. This form gives a more open head; the intervening space, if care is used in pruning, will be filled with bearing wood.

High or Low Tops.—Very few trees coming from the nursery suit all purchasers, some want high trees, some want low trees, and both may be right, depending very much on the method of the future treatment. Many successful orchardists are seen with either system. The man who wishes to keep his orchard in constant cultivation needs a somewhat higher trunk than the man who keeps it in sod, or who follows the mulch system. In the Paragon Fruit Farm we have our apple and pear headed with trunks from two feet to two and one-half feet high and heads started with five or six branches. The advocates of the high trees claim that the orchard must be cultivated, that if trees are low you cannot cultivate close to the tree and that trees that are high-trained always bear the finest fruit, that the bottom limbs are too much shaded, that the fruit, being deprived of air and sunshine fails to properly develop and lacks color. These assertions are entirely without foundation or reason. First, as to cultivation. With the proper implements, low-down trees can be cultivated without difficulty. At the Paragon Fruit Farm we have our peach trees planted fifteen feet apart each way, with a thirty-foot space every six rows. These trees, at the age of four years, have made such growth that they average about fourteen feet top diameter, many of them of certain varieties sixteen feet diameter; the limbs are overlapping each other, and they start from a trunk but one foot high, and instead of being trained upward, they are pruned to flat heads with side and lower limbs cut back but little. The lower limbs hang to the ground. To the uninitiated, this may seem impossible, when I tell you that this orchard is cultivated both ways from two to four times a week, from early spring until the beginning of July, sometimes later, and that we cultivate within six inches of the stem and very seldom injure a limb or knock off fruit. It is all in the knowing how, which will be told in another place. As to the fruit on the lower limbs lacking color and flavor, that is merely a fairy tale; our lower limbs with their ends resting on the ground bear bushels of fruit; in fact, more than the majority of the trees met with bear on the entire tree, as we frequently pick as much as two sixteen-quart baskets from the under limbs of single trees. Do they lack size? Well, we turn out bushels of them that fifty to sixty specimens make a half-bushel basket full. Does the man who claims to be a fruit grower not know that fruit properly

shaded always attains the largest size? I repeat, properly shaded. I do not mean to be choked, that neither air nor sunshine can get to it during the entire day, but that will shade it from the direct rays of the hot noonday sun. It takes abundance of foliage, healthy foliage, to develop a crop of perfect fruit, and this foliage should be distributed evenly over and through the tree that the sun's rays, ever shifting, and, with the gentle swaying of the branches, are permitted to permeate every portion of the tree. If the tree is trained as it should be, there is not one under limb that does not get its due proportion of the heavenly sunshine some time during the day. Do they lack color? Well, if you visit Paragon Fruit Farm during the season when we are harvesting the Champions', the Belle of Georgias', the Reeve's Favorites and others, you would wonder how so much liquid sunshine and beautiful prysmatic tints could be condensed within their velvety skins. Flavor, oh, ye Gods! Was ever such a delicious morsel given to man in any other form? Until within the last generation, trees of every kind of fruit and in every locality, were grown to very large trunks from five to eight feet high, the general idea being that a tree was not worthy the name of anything but a bush if it did not have this form. But of late years people are using better judgment, and the fallacy of high-headed trees is losing ground, and in every section low-headed trees are gaining more and more advocates.

Experience is teaching the orchardist that, although high-headed trees have the single advantage of permitting the operations of the plow under the trees and close to the trunks, low-headed trees have many advantages; they are far less liable to be damaged in their trunks by the many fatal diseases which attack them. In all parts of Pennsylvania during the midsummer the direct rays of the sun are very hot indeed, and if the limbs are high, affording no shade or protection to ward off the hot, blistering sun, the exposed parts in the southwestern quarter are sure to suffer and often entirely destroy the trees. Within the last two years we had some experience along this line. Having some varieties that were not up to our ideal as to quality, we top-worked several very strong, thrifty trees to Stayman Winesap, taking the precaution of leaving sufficient limbs so as not to prune the tree too much, likewise to partially shade limbs and trunk. The scions grew exceptionally well, making a growth of two to three feet with good, strong laterals. The following spring, by mistake of the man set to pruning these trees, these limbs that were left for protection were removed. The trees showed no ill effects during this second season, but upon examination the following spring, we found, with few exceptions, the bark was dead from twelve to eighteen inches from the ground on the western side, exposed to the afternoon sun, and many the entire

way round the trunk; and, as one of the unwritten laws on the Paragon Fruit Farm is to never, under any circumstances, permit a damaged or sick tree to remain, these trees were removed. A few trees of the same varieties grafted the same time, but without having their limbs removed, are clean, smooth and thrifty in limb and trunk. Had we taken the precaution to have covered the trunks with burlap, straw matting or rye straw, every tree would have been in good condition, as we have in no instance had the bark of any tree injured when so covered. Another advantage of low-headed trees is they are less liable to suffer from high winds; the leverage being so short, they stand firm while the long-stemmed trees are blown crooked. Another advantage of great importance of these times, when our orchards are suffering from the depredations of legions of insects, from every country with which we have business transactions, both masticating and sucking insects, and fungi of every description, which compel us to resort to spraying if we wish to raise marketable fruit, is that low-headed trees can be sprayed much more rapidly than high-topped trees.

There is also a very great saving in time and labor in gathering the fruit. One man can gather as much fruit from these low-down trees as two men from high-headed trees where long ladders must be used. Low-headed trees are always of easy access, and the spread of the branches gives the natural protection the trunk of the tree requires. They also shade the ground, keeping it cool and retaining the moisture in the soil, as cool, shady soil is not favorable to rapid evaporation; the soil never becomes compact, but remains loose and friable as we always find it in the virgin forests.

These are all very important advantages certainly, but cultivators are at liberty to choose for themselves, except to meet the wants of some particular circumstances. No standard tree should have a branchless stem more than three feet and two feet would be preferable, and I would advise any one buying nursery stock to purchase low-headed trees, with the lowest branches not more than thirty inches from the ground.

Age of Tree.—In ordering nursery stock be definite, state exactly what you want and in such positive terms that there can be no misunderstanding; an order somewhat like this:

"Mr. Jones,

"Dear Sir:

"Please book the following order, to be sent not later than ——. Stock to be choice, strong, vigorous, well-rooted trees, four to six feet, one year from the bud, free from insect and fungus diseases. Positively no substitution." Then specify varieties wanted.

This order will not strike the average nurseryman favorably. He would prefer more margin. He has, doubtless, some old mossbacks on hand that should have been consigned to the brush heap previous to this. I have in mind a certain nursery in Eastern Pennsylvania that has a large quantity of antediluvian stock in both pear and apple; they have been several times transplanted, with tops closely pruned to give them a young and thrifty appearance; but age will tell, and these prehistoric trees show lack of thrift in their long, bare trunks averaging about five feet high. Their bark is rough, hard, harsh to the feel, whereas in a young, thrifty tree, it is elastic, soft and smooth to the feel. On the Paragon Fruit Farm, bearing trees of ten years of age, with stems thirty inches in circumference, the bark upon pressure is as elastic as a piece of good, soft cork, and this should be the condition of all trees, and when it is not you may be sure something is radically wrong. Pass such stock by. Do not let yourself be persuaded that this is the stock to plant for quick bearing. In many cases you will never see the color of its fruit. The safe rule here is that, once stunted, never fully recover. Insist on having one or two-year-old trees. The reason for this is, first, when you get a tree four to six feet from the bud (one year bud, two year stock), you have the very cream out of the nursery. Any one familiar with nursery business knows that comparatively few attain that size at that age, the larger proportion being from one to two feet. But when you get trees up to four, five or six feet you have a tree with strong individuality, a strong root system, one that when properly pruned in root and top scarcely feels the effects of transplanting; and I will guarantee they will come into profitable bearing sooner, and that in the first ten years of their existence in the orchard, they will produce fifty per cent. more fruit than the older trees.

This is not the only desideratum, but tops can be formed to suit all, at any height desired and with as many branches, and these can be trained to any form. The kind of a top the tree is to have is developed with the first season's pruning, which should be given early in the spring, generally in March.

Having decided upon the age and size of the tree, the first step on receipt of the stock requires good judgment. If they arrive (as frequently happens) during a cold snap, and the stock is frozen, put the box in a tight wagon shed or some empty stable, and cover with straw or strawy manure, to give them time to thaw out gradually; or, if they are poorly packed, with insufficient moss or other suitable packing material, carefully remove the boards on one side, bottom preferred, as the trees on being packed are forced down, and in doing so the ends of the branches, as well as the roots, are bent, with the ends braced upward against the sides and ends of the box, by re-

moving the bottom the trees can be removed with much less difficulty. But for the time being, disturb the trees as little as possible, merely removing the boards, then, with a watering pot, sprinkle both roots and tops until thoroughly moistened, and cover thickly and leave until they are thawed out and the ground is in fit condition to set out, or if the orchard site is not ready for immediate planting, then heel carefully in trenches until you have the soil in good condition.

When ready for planting remove the trees from the box, or trench, and carefully prune the roots; examine them carefully, remove with a sharp knife every mutilated root, making a smooth, clean cut, then cut back all roots to the proper length and remove entirely all superfluous roots. Should you find any with root gall or crown gall, throw them in the brush pile to be burned, as they can never be cured, and it will be money in your pocket to destroy them at once and not waste precious time endeavoring to save them. To prune the roots, hold the tree at an angle of about forty-five degrees, with the top pointing downward, thus bringing the roots in the best and most convenient position for pruning. Cut back every root, whether mutilated or not. Do this with a smooth, clean cut on the underside of the root from the center outward. This brings the plane of the cut surface downward when planted. This wound will soon callous, and from this callous new roots start outward and downward, and, in a short time, firmly anchor the tree.

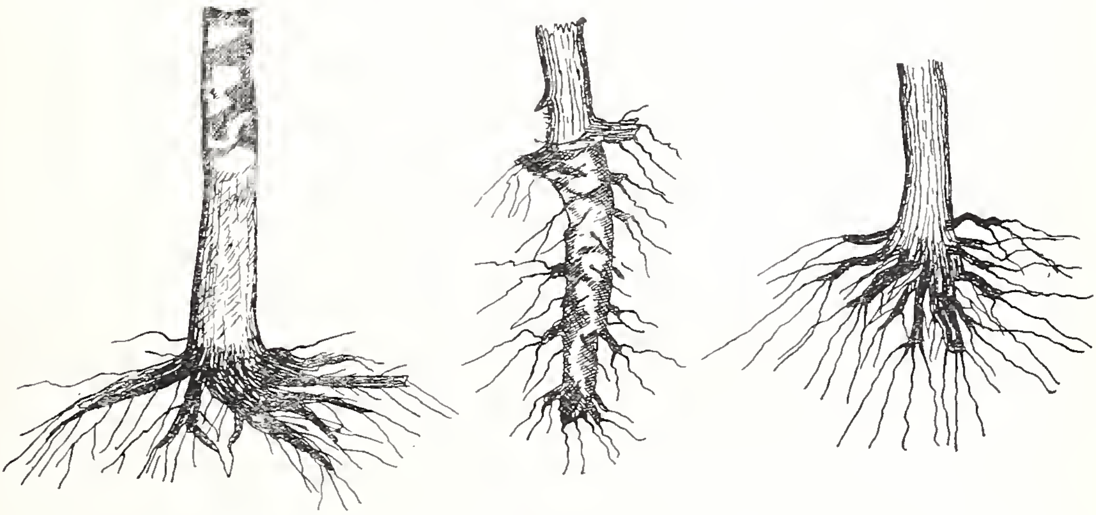
Many planters disclaim any advantage in this mode of pruning, claiming that the new roots eminate from the bark of the larger roots, or from the fibrous roots and seldom from the calloused ends. This is incorrect. A few years ago I purchased several thousand one-year-old apple and pear of some of the newer varieties and planted these, after carefully pruning the roots into trenches. Leaving them stand one year they made exceptional fine growth. The following spring, upon digging them for transplanting, I found fully ninety-five per cent. of the cut roots had from three to five strong, vigorous roots, from twelve to twenty-four inches in length, starting directly from the calloused ends.

Leave the roots from five to eight inches, not longer. This is about the happy medium for pruning the roots for general planting. Many planters advocate leaving the roots as long as possible, claiming they will give more nourishment. In theory this seems plausible, but is not practically correct, as it is found that trees with roots properly pruned make a stronger growth and stand firmer than long-rooted ones. (See methods of root pruning on Fig. 23.)

Shaping the Newly Planted Tree.—If the transplanted trees are one year from the bud, thrifty and vigorous, four to six feet high, without branches, they are full of dormant buds, from the crown to

the tip (See Fig. 24); and if this were left unpruned, as nine out of every ten are left, a very large number of these buds will push out, completely surrounding the stock and, if left to grow, will soon deprive the tree of its vitality, and it will make little growth.

Having decided on the height you wish to head the trees, you make a clean, upward cut just above a good, sound bud. If made too far above, the stub will die back to the bud, but if cut close it will soon heal over. In a short time, being deprived of its top, the dormant buds between the crown and the upper bud push out strong side shoots. When these are one-half inch in length you are ready to form the permanent top. For the apple and pear, five or six strong shoots are left. These shoots, below this point, are rubbed off by grasping the stem loosely and giving it a downward sweep.



8. Inch pruned roots. Stub pruned. 5. Inch pruned.

Fig. 23. Shows three methods of pruning. Also, the new roots grown from the cut ends of the roots.

Those branches that remain make a rapid growth from this time, and they must have intelligent attention given them. If left to mature, two or three of the uppermost shoots often absorb the majority of the nutriment furnished by the roots. These become leaders and frequently are equally strong. This gives rise to a condition that must be avoided, or the worst of all forms will be produced, a forked tree, which, when in full bearing, is likely to split and ruin the tree. But, with judicious pinching of these strong shoots, save the uppermost one, their growth is somewhat checked, the one not pinched back becomes a leader, the weaker ones receive more nourishment and make a strong growth; the proper equilibrium is established, and these shoots are converted into good side branches around the leader, become shouldered and capable with age of bearing heavy burdens without splitting or breaking. It will be neces-

sary to go over the trees several times during the summer, pinching back, perhaps the leader or one or two side shoots; removing surplus branches that start out from the stem and rob the parts you wish to develope. When a branch is headed back cut above an outside bud. This gives new growth an outward spreading form. If

Fig. 24. One-year old Apple tree, 6 feet high. Lines show where to cut back.

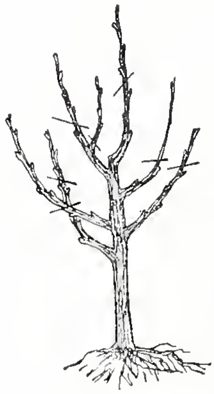


Fig. 25. Two-year old tree with lines where to cut back.

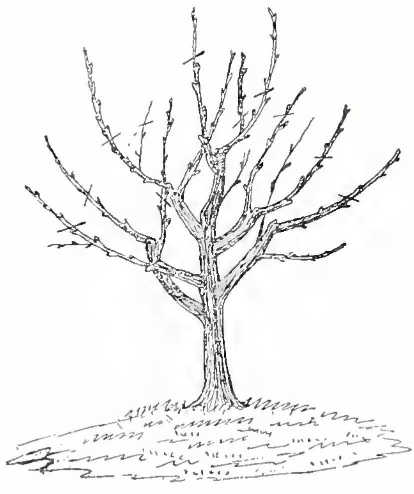


Fig. 26. Three years old. Lines where to cut back.

Fig. 27. Four years old with fruit spurs formed.

the planter has given the judicious care necessary, he will have a strong, well-balanced top, supported by a stout, vigorous stem, by the end of the season.

Should the trees purchased be two years old, with tops already formed, the treatment is entirely different. It is seldom that trees

can be obtained with ideal top formation, and to correct these defects is something like correcting bad habits. If the top is badly formed, as we often find them, having two or three equally strong shoots standing nearly erect, it will be better, if the head is not too high, to remove all but the strongest one, cut this back to the proper height and form a new head.

Should the tree have a well-formed head, cut back all the branches, removing from two-thirds to three-fourths of the previous season's growth, excepting the one nearest the perpendicular, which should be left somewhat longer to become a leader. In cutting back, make a slanting cut immediately above an outside bud to form a more open head.

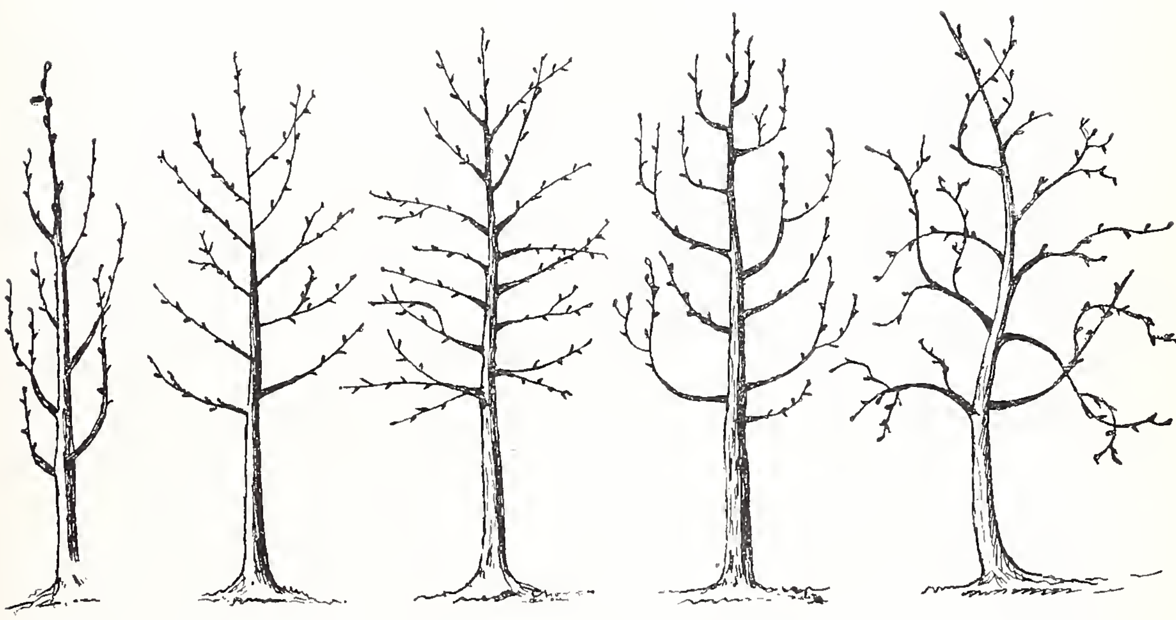


Fig. 28 Erect. Fig. 29 Diverging. Fig. 30 Spreading. Fig. 31 Ascending. Fig. 32 Straggling.

Fig. 24 shows a one-year apple, with buds and marks where the top should be cut off.

At the end of the first year the tree should look something like that shown in Fig. 25, with strong, sturdy branches, well set and well distributed, forming a good scaffold or framework upon which to build the future tree. This is a stage where sound judgment is required, for if a mistake is made now it cannot be remedied later. This is acquired only by observation, or by practical experience. The natural shape or form of growth of the tree must be known, and this must be taken into consideration in forming the tree. (Figs. 28, 29, 30, 31, 32 show different forms of growth.)

Fig. 28.—Erect, with shoots rising nearly perpendicularly from the tree, as in the Yellow Transparent apple and the Bartlett pear.

Fig. 29.—Diverging, when the shoots deviate from the perpendicular at an angle of about forty-five degrees, as in the Dominie.

Fig. 30.—Spreading, when the shoots assume nearly a horizontal direction, as in the Rhode Island Greening and the Mammoth Black Twig apple, these frequently become drooping.

Fig. 31.—Ascending, when the shoots curve upward, as in some of the crab apples and in the Gravenstein apple.

Fig. 32.—Straggling, irregular, when they assume no particular form of growth, but a mixture. The Winter Nellis pear is a fair example of this type.

Shoots are straight, as in the Early Harvest and Northern Spy apple; flexuous, when deviating from a straight line, as in the Roxbury Russet. This distinction is very apparent in young and thrifty trees, but less marked as the tree assumes age or becomes feeble in growth. They are stout, as in the Stayman Winesap and Red Astrachan apples; slender and willowy, as in the Jonathan apple and Winter Nellis pear. Trees with erect, straight shoots when young, usually form regular, compact heads with age, and those of a spreading habit, become more irregular and drooping when in bearing.

Some trees that are very rapid growers when young are small when mature; others grow more slowly, but attain immense size when full grown. Some varieties, like the Northern Spy, continue to grow rapidly in size at all periods; while others of feeble growth while young never attain a large size.

Some varieties come into bearing at a very early age, even at two years of age in the nursery row, as the Bismark and Yellow Transparent apples, while others, like the Northern Spy (unless pruned specially for the development of fruit spurs), requires several years before it shows any signs of fruiting.

All of these things should receive due consideration before any one can intelligently prune and train the tree through this, the most critical stage of its existence. The tree in Fig. 28 requires entirely different treatment from that of Fig. 30; the first being very erect if left to nature, forms a very close, compact head. Judicious pruning, always cutting the shoot off above an outside bud, makes it more spreading, and by repeated pruning of this sort, we get an open head formed. Whereas the tree that is already spreading requires such pruning that will give the shoots a more upright growth. This can be done by cutting beyond an upper bud, the young shoot starting from this bud will assume a perpendicular growth.

A tree is a collection or colony of individual plants, each branch, even every joint of a branch, is endeavoring to do what every other branch does—to bear leaves, flowers and seeds. Every branch competes with every other branch, and there are more germs of branches —that is, buds,—than there can be branches upon any tree. So it

comes that no two branches of a tree are exactly alike, but are what their position or condition makes them to be. Some are strong, some are weak. There is no definite size or shape for any branch, as there is for the bloom or a member of the animal kingdom. A branch never attains its full size, when it ceases to grow, it ceases to be healthy and soon dies.

Branches are not organs, but competing individuals. If these statements be true, then three conclusions follow: There is a struggle for existence among the branches of a tree and some of the contestants must perish; the destruction of these conduces to the strength and vitality of those remaining; all of the branches of a tree are not necessary; some of them are a detriment, pruning becomes a necessity.

Nature prunes to meet her ends. In young trees she prunes but little; but, as the tree attains age and size, the natural thinning of the top begins and continues in geometrical ratio as long as the tree grows, and after a time this pruning becomes more severe, larger branches will be sacrificed. Probably less than a fifth of the buds upon a tree ever make branches, and less than a fifth of the branches survive. The greater part of these branches die before they come to bearing age. A forest tree grows a tall, straight trunk because the side branches have been lopped off, and the more vigorous the pruning, the taller and stronger the tree becomes. The trunk of these trees is the remainder of a long problem of substraction.

Every tree is a record of defeats and disasters in order that the stronger parts may live. It is safe to conclude that, if nature is such a constant pruner, man may prune too. Those persons who declaim that pruning is unnatural should be taken to the orchard that has been neglected and see what is transpiring there.

It may be claimed that artificial pruning is too severe; but it is not different in kind from natural pruning, and it is fully warranted by the different objects in view. The ultimate object in nature is the production of seeds, and the more seeds produced the better. Therefore, large numbers of small fruits well filled with seeds, carries out Nature's object better than a small number of large fruit. Man covets the fleshy portion of the fruit, which is of less importance to the tree. He must, therefore, thin the tree, removing all useless branches that are struggling for existence. In order that size and quality may take the place of numbers, he deflects the energy into another channel.

It is a common assertion that cutting off a limb injures the tree, because it removes a given amount of tissue, in the production of which the tree expended energy; that pruning exhausts the tree. This would be assuming that the tree has a certain fixed vitality from which a given amount is withdrawn when a portion of the tree

is cut way, and that the tissue could have been saved to the tree by directing it into other parts of the top by means of earlier pruning. This is true to a certain extent, for that reason we strongly advocate early and continued pruning, thus building up the ideal tree in the shortest time. But, in doing this, the saving results only in economy of time, by building up the other parts earlier in the lifetime of the tree, and not in economy of vitality, for vitality is constantly being renewed. The question here rises, do we really save a proportionate amount of time by heroic pruning in the young tree after the head is formed? Can we direct the same amount of growth into the remaining portions of the tree, as we can by pruning when the superfluous branches have attained some size and have, perhaps, began to bear?

There is an exact balance between the feeding capacity of the plant—that is, its root system and food supply—and the superficial growth of the tree. The more active and efficient the root, the more abundant the food, the larger the top. If we remove a large proportion of this top, the tree endeavors to supply the deficiency by a very vigorous growth. So, pruned plants are nearly always more vigorous that unpruned plants, because of the concentration of a somewhat constant food supply into a smaller number of branches. Therefore, pruning must have the same effect as manuring. The stimulating effect of this new growth, or the new disposition of energy, must be felt upon the root system also, and it is a point for discussion as to whether this stimulus and response to new conditions may not be greater when the pruning is somewhat heroic than when it is distributed over the lifetime of the tree as to be imperceptible. Growth is certainly much stronger when heroic pruning is done, but it may not be greater in sum than that which follows several prunings of equal aggregate severity.

I am fully convinced by observation and my own practical experience that annual pruning of fruit trees is beneficial. I am just as firmly convinced that it does not pay, either for the good of the tree, or in cost of pruning, to cut all superfluous twigs at each pruning. These twigs can, with benefit, be left until they are three or four years old with advantage; they should not be left until they are so large that their ultimate removal will considerably unbalance the tree, but their great benefit lies in their acting as a sun screen, sheltering and protecting the parts of the top from the harmful exposure to the direct rays of the hot sun and lessen the danger of over pruning, by which the nutrition of the tree may be injured.

Pruning increases the vigor of the tree when judiciously done. When a tree is injured by overpruning, it is not, as many claim, by the shock, for a tree has no nerves. It is often said the time of year when pruning is done influences the amount of growth. It is said

winter pruning makes more wood, and pruning in summer makes fruit. This is more or less true. Winter pruning makes more wood because it has the full season for growth, and the season's growth is nearly completed when summer pruning is performed. Pruning, of itself, cannot be injurious so long as it does not interfere with the nutrition of the plant. It is important to explain how this interference occurs. A certain plant derives a certain amount of its food from the soil, in the shape of soluble inorganic matter. These materials ascend to the leaves through the young wood and become associated with organized compounds, like starch and sugar. These organized compounds are used in the repair and growth of all parts of the plant, and they are, therefore, distributed to the leaves, trunk and roots. The growth of the roots is, therefore, largely determined by the amount and vigor of the top or leaf-bearing portion. The removal of the greater portion of the top may interfere, therefore, with the vigor of the tree by preventing the supply of a sufficient amount of elaborated food.

If pruning is not devitalizing, if the removal of strong branches induces vigorous growth in the remaining ones, and if there is little danger of disturbing the nutrition of the tree, why can there be any objection to the removal of large branches? The removal of such branches may not be objectionable so far as direct injury or shock to the vitality of the tree is concerned. But there are important reasons why large branches should not be removed. Such pruning exposes dangerous wounds; it is apt to open the tree so much that some of the remaining parts scald, and borers obtain a foothold; it spoils the symmetry or convenience of the tree, and such branches may represent a certain amount of energy which should have been earlier directed elsewhere; but I should much prefer the removal of such large limbs to total neglect. I have, on occasion, removed large branches from old, neglected trees that have responded promptly, showing increased vigor and health, together with a considerable increase in fruit.

If philosophy and physiology teach that pruning is not devitalizing, experience affords still stronger proof. One of the most absurd teachings in horticultural literature is to prune only with the knife, thereby avoiding the removal of large limbs. Any one who prunes thoroughly knows the fallacy of this statement. If permanent, successful practice and scientific teaching are opposed, then the scientific teaching is in error. I have frequently observed that well-pruned trees live as long as unpruned, and I believe they live longer, as their vitality is not exhausted by supporting useless branches and they produce much more and better fruit during their lifetime.

But suppose pruning would be devitalizing, even then we could not afford to discontinue it. The gain in size, color and flavor of the fruit, the ease of cultivation, spraying etc., are advantages the progressive horticulturist can never forego.

When the planter has familiarized himself with the habits of the trees portrayed in the different figures and knows exactly for what he is pruning, then he is ready for the next step, that of giving the tree its second pruning.

By turning back to Fig. 25, which shows a well-formed two-year-old tree, you will observe the cross lines indicate where the branches are to be cut. It will be noted that the tree is of the diverging type, with branches at an angle of about forty-five degrees. Were the tree like Fig. 30 or Fig. 32, some of the marks would be placed beyond an upper or lateral bud, as the operator must carry in view what the tree will resemble when another year's growth is added.

The principle attention required after this will be to maintain a uniform growth among the branches and their members and divisions, and to prevent the growth of shoots in the center. The leading defect in all our orchards is too much wood. The heads are kept so dense with small shoots that the sun and air are, in a great measure, excluded, and the fruit on the outside of the tree only is marketable and fit for use. This is one of the reasons why so many condemn low down trees, claiming the fruit does not color and is insipid on the bottom limbs. The head should be kept open, so that the wood, leaves, blossoms and fruit may all, in every part, enjoy the full benefit of the sun and air, without which they cannot perform their functions and attain maturity and perfection.

Too many people imagine, when the trees are planted and the heads started, that the trees can take care of themselves, as the trees in the forest, on the ground that Nature preserves a balance in all her works; but it should be borne in mind that a fruit tree is not exactly a natural production. It is far removed from the natural state by culture, and the farther it is removed, that is, the more its nature is refined and improved, the more care it requires.

Treatment of the Growing Shoots.—The tree being well established, in root, stem and top, on being so severely pruned back, nearly all the buds on the shortened branches start out with vigor. When these have made a growth of an inch or two, their force and forwardness will indicate the uses to be made of them. Each of the main branches of the first section may be considered as a stem; its leader will require the same treatment to favor its extension. At this time a secondary branch may be required to fill up a space, which widens as the branches extend. If so, a shoot is selected for this purpose, and the others on the same trunk are removed or checked at two inches and converted into fruit spurs. The laterals

are treated this way. The second section now in process of formation must be managed as in first section. The requisite number of shoots are preserved, and the superfluous ones removed early; the leader and the upper laterals are always inclined to more vigorous growth than the lower ones; must be checked to hold them in proper condition relative to those below them. A very common error in top formation is to have the branches too close to each other, so that when they come to bear, the wood, foliage and fruit on the interior are so excluded from air and light that they all suffer; the fruit is imperfect, and the spurs become feeble and gradually die.

The Third and Fourth Years.—The frame work is now well formed so that from this time on less attention will be required. Surplus branches and those that rub, or are inclined to form crotches, should be removed; very vigorous trees must be headed in. By this time many of the trees will have fruit spurs developed, as very many varieties, by proper treatment, are in profitable bearing at six or eight years. At the Paragon Fruit Farm the Stayman Winesap, Rome Beauty, Salome, Gano and others have been producing one to three bushels of fruit per tree at six and seven years of age, and last season, 1905, trees of ten years of age bore from eight to ten bushels per tree.

One of the peculiar effects of high altitude, with the accompanying sunshine, is that it induces fruitfulness and early bearing, and the tendency of young trees to overbear is pronounced; we are, therefore, seldom required to give special pruning to produce fruitfulness. Should such be necessary, the following should be borne in mind; prune in winter for wood and in summer for fruit. This is true for the reason that summer pruning checks the growth of the tree, by removing a portion of the leaf surface; this, with less nitrogeneous food and more of the mineral elements, such as some form of potash and the dissolved South Carolina rock greatly aids in developing them good, strong fruit spurs and the growing and maturing of the fruit. The top should be thinned out every year. No general rule can be given, as each tree presents a different problem. A thick growth of branches results in weak-bearing shoots and spurs, and, finally, when cutting back limbs on bearing trees, the cut should be made just above a strong lateral wherever possible. The tendency of the sap will be to flow into the lateral and thus prevent the formation of numerous branches, which nearly always results when a so-called stub cut is made.

A number of our best varieties of apples are apt to develop long, slender branches which may bend and rest on the ground, and, indeed, it is not uncommon for such branches to break under a load of fruit. Some of these kinds, like the Winesap, are very apt to overbear periodically as they get older, often to such an extent that the

branches are broken down with a load of undersized fruit. It may take such trees two or three years to recover from the effects of over-bearing, but the third year the process may be repeated. A severe heading in and thinning out of the branches will largely correct this fault and make it possible for the trees to bear annual crops of fine fruit.

But one must become familiar with the habit of growth of the different varieties, as a few kinds grow slowly and will not bear heavy pruning; others are erect growers, some are spreading, as previously shown. One cannot expect to entirely overcome such tendencies, but they may be corrected to a marked degree. The upright varieties may be spread by pruning to outside laterals, and the spreading kind contracted by cutting to those having an inward direction; and by cutting back the vigorous growth each season the limbs are made stocky, thus, in a great measure, doing away with drooping branches. I believe it is always, under all conditions, advantageous to keep the trees from becoming tall. This can only be done by intelligent annual pruning.

WHY DO WE PRUNE

It is surprising how few have any idea of the problems at issue in pruning, and of the factors which modify the results. There is no set of rules, no laws enacted for the guidance of the intending fruit raiser upon which he can act. There are two great classes of ideas concerned in pruning—those which directly affect the welfare of the plant or tree and those which are associated with the mere form and size to which the tree shall attain. The former means pruning proper, the latter a question of training, which depends upon the taste, or ability of the pruner. It is a question as to whether you desire a high head or a low one, whether a flat top or a conical one. It is a case of you pay your money and you take your choice, it is a personal preference. Of all the operations pertaining to fruit raising, that of pruning brings you into closest sympathy with the plant; that brings you in love with the calling. I never feel happier or more contented with my lot than when I am among my beautiful trees, pruning, training, guiding, nursing and feeding. There is a chord of sympathetic feeling existing between my plants and myself that even the trees seem to acknowledge, for they bow their heads in pleasant recognition at my approach; they invite me sit beneath their gently swaying branches, and protect me from the scorching rays of the summer sum; they acknowledge their gratefulness for favors shown by yielding bountiful crops of the richest and most luscious fruit.

There are some persons who cannot bring themselves into this close sympathy with a tree, a shrub, or flower; the jingle of the al-

mighty dollar has so warped their natures and desires that they see no beauty in any of Nature's handiwork. They are the ones who prune with an axe, anxious to get done with the job; they know not that the tree responds to ever affectionate touch and that pruning creates a sort of fellowship between the tree and the owner.

Let us now endeavor to find a few general principles upon which all can agree, those principles which underlie the practice of pruning and training. Some of these principles have been touched upon previously, but all of them are fundamental truths and will bear repetition. Principles must come first if practice is to be satisfactory. When the principle is understood the details can be worked out on the tree itself. Before entering upon this subject, let us fully understand why we prune.

1. To modify the vigor of the plant, this may be by increasing or diminishing its vigor.
2. To produce the fruit that will be larger and better.
3. To keep the tree in proper and convenient shape.
4. To change the habit of the tree, if growing too much wood, to bring it into fruiting.
5. To remove superfluous or injured parts.
6. To facilitate spraying and harvesting.
7. To facilitate tillage and improve the convenience of the plantation.
8. To train the tree in some desired form.

Heavy Pruning Increases Wood Growth.—Under natural conditions a tree is perfectly balanced between top and roots; they support and nourish each other; one cannot be injured without the other suffering; they respond to each other. The more root a tree has, the greater amount of raw material taken in, and the greater amount of these materials, the greater must be the elaborated leaf surface, and the greater, therefore, the growth of all parts of the tree. If you prune or cut away a large proportion of the top and the root is left untouched, the equilibrium is broken, an equal amount of root supplies the smaller top; there is more food for all the remaining branches, the result is a more vigorous growth of these parts than they would have made, or new parts—suckers—may arise.

If it is necessary to resort to severe pruning, it should be done gradually, never cutting away too much at one time and thus avoiding excessive growth. We find in renovating old orchards that have not been pruned for several years and large limbs are removed, a great profusion of water sprouts arise around the wound and along the main limbs. If, on the other hand, we reverse this order and prune off a portion of the roots, leaving the top intact, we lessen the wood growth, the food supply is cut off and the top suffers from

lack of nutriment. If a tree shows a sign of weakness, whether from a surplus of branches or from overproduction, etc., the pruning of the top tends to put energy and new growth into the tree; and, by judicious feeding, in conjunction with pruning away the weaker parts, the tree is again put into a healthy, thrifty condition. If some of the weaker branches do not respond to the treatment, then develop water sprouts and form a new head from these.

This rule holds good, heavy pruning for wood, light pruning to maintain health and habitual annual bearing. If it is desirous to even up the branches of a tree, prune back the strong branches severely and the weaker ones only moderately or not at all, and thereby throw the energy into the weaker shoots. We frequently resort to this type of pruning in the Summer. This method of pruning is adopted at the Paragon Fruit Farm, and it is a surprise to most visitors to see the uniform thrift of the entire orchard, but constant vigilance is the price we pay. Any tree, on the first symptoms of distress, is critically examined, a diagnosis formed and the remedy promptly given. Never wait for a more suitable occasion. A tree is generally quick to tell you when something is wrong and also quick to respond; if color is lacking, it generally needs nitrogen. Trees exposed to low temperatures frequently suffer from freezing. For this, the best remedy is to cut away all the injured portion, as it is of no future use to the tree, but a positive detriment by hastening the evaporation of moisture. By cutting away the frozen branches to mere stubs, you throw all the energy of the tree into a small space, and as heavy pruning tends toward wood production, this is just what is most needed to renew the vitality of the tree. The browned and injured wood can never again regain its former usefulness; new tissue must be developed as quickly as possible, in order to carry forward and maintain the vegetative energies. This new tissue is laid on over the old, and the old thereby becomes sealed in and removed from the agency of decay. All the energies being directed to the development of new tissues, the injury is soon overcome. The injured wood, like the heartwood of the tree, is soon removed from active participation in the vital processes. The danger, therefore, resulting from the browning of the wood depends very largely upon the subsequent treatment of the plant.

A Pruned Tree Tends to Resume Its Natural Habit.—Every plant has its own individuality and every tree is unlike every other tree, whether it be erect, spreading, conical, or round-headed. In whatever way a tree may be pruned, it immediately makes an effort to assume its natural habit, and the more vigorous the tree, the more rapidly does it resume its former state. The Northern Spy tends to grow erect; the Mammoth Black Twig, spreading, and the Jonathan, drooping. It is evident, therefore, that the better method is, as far

as practicable, to allow the tree to take its natural form; but in our day there is a limit to this. For convenience, we desire all our trees to be low-headed, therefore we must prune to that effect, and when they attain fruiting age, the production of fruit tends to broaden the top and reduce the annual growth.

Watersprouts.—These are the result of heavy pruning or anything that disturbs the equilibrium of the tree, regardless of the season of pruning, but vigorous trees send out many more than one of weak constitution, and early Spring pruning sends out more than late Summer pruning, as at this season the growth of the tree is over, and by the time growth begins in the following Spring, the equilibrium is again more or less established, and instead of expending its energies on growing waterspouts, it exerts its forces in the extension of existing branches. But no one should let the fear of waterspouts interfere with pruning at the season that best suits the object to be obtained. And in pruning old orchards that have been long neglected, the object is generally to put new vigor into the tree, as well as to reduce the large mass of unproductive wood, and for this purpose the best season is in early Spring. Wherever large limbs are cut off, great clusters of watersprouts frequently start out. These can be removed later by a second pruning, and, should there be an open space, one of these can be left stand and trained into a limb for the future benefit of the tree. Another reason for removing large limbs in the Spring is that a large wound is made, and should this be made late in the season or fall, the wound is exposed for several months to the action of freezing and drying out of the exposed part, which frequently kills it back an inch or more; whereas if the wound is made in the Spring, a clean cut close to the tree, Nature loses little time before she begins the healing process. But if the branch is pruned to a stub extending several inches from the stem, as we too frequently see in orchards, Nature cannot do her part; the stub dies back gradually until it reaches the shoulder, where a line of demarkation is made; the extended part decays, drops off; the decay continues into the wood tissue of the remaining limb or trunk; water gets in, and from this time decay goes on more rapidly, until it reaches the heart of the tree, often leaving a mere shell to be blown down by a heavy gale or broken by its load of fruit. This is all owing to the lack of intelligence of the pruner. Unfortunately, this is not always done by the farmer or the beginner in orcharding, but too often by the professional tree pruner—one who makes it his business Spring and Fall to go around and solicit the job of pruning orchards and charging a good, round price for the privilege of ruining the orchard. There should be a law enacted making it a criminal offence, punishable by fine and imprisonment, for any one who does not understand the business to pose as a

pruner, and thus impose upon the innocent victim, and this fine should be sufficient to fully pay commercial value for every tree he thus mutilates.

Where large wounds are made they should be covered with some dressing that will cover the wound, sealing it to keep out water and prevent the drying out of the wood tissues. This dressing must be of such nature as not to injure the cambium and thus be more injury than benefit. It must be protective; it must be antiseptic; it must act as a fungicide to prevent the growth of fungi and bacteria. For this purpose it must also have durability, it must adhere closely to the wood. I find on wounds made on my thrifty trees that lime-sulphur spray is an excellent cover; it is an antiseptic; it is a fungicide of the highest order; it remains on the cut part the entire season, entirely preventing decay; it cleans the trunk and branches of fungi and lichen or moss; it softens the bark and prevents the tree from becoming bark-bound.

Paint, tar, coal-tar, etc., are recommended and often used to the serious loss of the orchardist. They should be used with a great deal of caution. Coal-tar in any form is very dangerous, even tarred paper put around trees to keep off borers has, in many instances, killed valuable young trees. Paints are safer; but before using them you should know of what they are made, as many of the ready mixed paints are composed of ingredients that are injurious to living wood tissue and bark. The best covering for all purposes is pure lead paint, mixed with pure linseed oil. Put on a thick coat of this; it will protect the exposed part until Nature covers the wound permanently, and it is not injurious.

When to Prune.—Is a question repeatedly asked by the beginner, and there are as many answers as there are months in the year; which is evidence that the season does not materially affect the health and vitality of the tree. The principal requirement is to know how to prune and what you are pruning for. When a tree needs pruning for some particular cause, attend to it at once; never put it off for a more opportune time. The time of year in which the wound is made is less important than some other factors. The healing of wounds, we have seen, depends upon the cambium. Healing cannot begin, therefore, when the cambium is inactive, as it is in late Fall or Winter. We have also seen that exposed tissues may die back during the Winter. There is always a tendency for the cambium and bark to die back about the edges of the wound made in Winter, which is more or less a disadvantage to the process of healing. On the other hand, pruning in the growing season of Spring causes many trees and vines to bleed profusely, which by many is considered very injurious to the tree; although we prefer pruning a little earlier or a little later that this bleeding will not

take place, yet severe injury rarely results. Fruit trees rarely bleed to any extent, and can, therefore, be pruned at any time. For general purposes, the ideal time is from early Spring until growth begins.

Treatment of Injured Trees.—Our trees are subject to injuries from various causes. Some of them are serious and need prompt and effective treatment if we wish to save them. One of the most common is that of splitting down of limbs during the bearing season, branches that are heavily laden. This seldom happens to a properly trained tree, with the up-to-date orchardist. Trees that are badly formed, with one, two or more crotches, are very apt to split apart if they are left to overbear. Should such a thing happen and the split be beyond remedy, then cut away, dressing the wound as smoothly as possible and applying a dressing of some kind. But, if observed in time, when the split begins, reduce the crop of fruit to lighten the load on the branch, and secure the same by boring a half-inch hole with a sharp augur through the split limb and the adjoining one, or stem, as it may be; through these holes put a bolt of sufficient length, with a head on one end and a long thread on the other; then, with the nut and washer between, you can draw the parts close together. Cover well with grafting wax. The wound quickly heals; the new growth, in a few years, so completely covers the head and nut that they can no longer be seen.

Several years ago a large yellow Belleflower tree (in the home orchard), the trunk of which was about four feet to where it divided into two equally large limbs, which was a heavy bearer, and under the strain of a heavy crop, split apart. Not wishing to lose the tree, we attached a rope and pulleys and drew the divided parts together and bolted as before described. In a few years the bark and new wood completely covered the wound and bolt ends. This tree continued in good health and bore good crops for more than a quarter of a century; and last Spring, when it was cut away to make room for more desirable varieties, which it somewhat crowded, we found the union of this split crotch complete, with no decay of the wood whatever.

As neat a brace as I ever saw was made by taking a watersprout which grew from one branch of a forked tree about two feet above the crotch, and in arching the other end and securing it into the other branch. This union was perfect and in a few years this formed a solid living brace, removing all danger of splitting apart. We occasionally see this in the forests, where the limb of one tree has become inarched into another. At the falls of French creek, Chester County, Pennsylvania, there are two maple trees thus attached together, at a height of about ten feet from the ground. The union is

so complete they may be considered as a pair of twins; though connected, each is independent of the other.

Girdling.—Another cause of serious injury to trees, and one that I think destroys as many as any other, is girdling by mice, rabbits and borers, all of which can be avoided by proper treatment. But we frequently see, in fact, it is a yearly occurrence in orchards all over the country, that field mice girdle or partly girdle the tree, by eating away the bark around the tree. Were it the bark alone that was removed, it would not be so serious, as a new bark would soon take the place of the old one; but they eat away the cambium—the soft part—through which the sap descends. Circulation is interfered with; the tree does not die at once, but may linger for years, but sooner or later (depending at what time the injury takes place), the tree must succumb. Several years ago I had a portion of the orchard in heavy clover sod. Through an oversight we omitted hilling up around two Ben Davis apple trees, and through the Winter the short-tailed field mice completely barked these trees, leaving not a scrap of cambium. The following spring these trees came into leaf, opened their bloom and set a fine crop of fruit, which matured a trifle earlier than the fruit on the adjoining trees, and was, perhaps, a trifle undersize. Nature did her best to remedy the injury; granulations were thrown out around the entire tree at both the upper and lower portions of the wound, but this being over six inches apart, connections could not be made. It was observable that the stem did not increase in thickness below the wound, but above the wound the growth was quite perceptible. The following Spring these trees again came into foliage and bloom, only the foliage was of a more sickly hue; but another crop of fruit set and came to maturity as the previous season, but had only half the size of the fruit on the other trees. The stem above the wound continued to increase, but there was no increase below; the foliage dropped early. The third Spring the tree, in its last effort, again came into leaf and bloom; but you noted the signal of distress, the foliage was dwarfed, sickly in appearance; the fruit set a very full crop, but when they had attained the size of hickory nuts, the trees finally gave up the struggle for existence and died. Should the girdling be only partial, should a small piece of bark. or even a narrow tortuous strip of cambium be left, the tree may, and, in many instances, does survive, gradually healing, until the entire tree be again covered with bark.

How Does This Happen?—Let us for a moment consider the make-up of the stem of a tree or branch The wood portion is tightly enveloped in a cylinder of bark and in most instances the increase in the dimensions takes place by the formation of rings of new tissue (or new wood) under the bark; and all the growth in thickness takes place upon the inside of this cylinder and never upon the outside. It

is evident that the bark must expand in order to allow the expansion of the woody cylinder within it. The tissues are under constant pressure, often amounting to forty or fifty pounds to the square inch. If the bark should, from any cause, become hard that it cannot expand, the tree is termed bark-bound. This condition frequently exists in old orchards, in fact, old, and neglected orchards, are rarely found in any other condition.

In these cases the remedy is to release the tension. Many advise the slitting open of the bark; this may be of service in bad cases. We frequently find rapidly growing trees will crack the bark, often the entire length of the stem. When this is done with the knife, a strong, sharp knife is used and a deep cut entirely through the bark is made the entire length of the stem. The crack, hardly discernible, at first, opens with the growth of the tree, filling up with new tissue beneath. Slit a rapidly growing limb with a sharp knife in the Spring and watch the result during the season. See how much faster this side will grow. Advantage is frequently taken of this fact to

Straighten Crooked Trees.—Many varieties of trees are naturally crooked growers. The progressive orchardist takes too much pride in the appearance of his orchard to have crooked, ill-shaped trees, so he resorts to one of two methods to overcome this defect. He either topworks the crooked variety upon some strong growing, straight-stemmed variety, such as the Northern Spy, Mammoth Black Twig, etc., or he plants the crooked variety as obtained from nursery, fertilizes well to get vigorous growth, then, in early Spring, with a sharp knife he makes two or three deep incisions entirely through the bark and cambium, the entire length of the crook, in the concave portion. Nature, in her efforts to repair the injury, throws out granulations along the entire length of the cuts. Much more wood-making material is deposited in this section; growth takes place much more rapidly, at the expense of the convex portion, and in a few years the crooked trunk will be as straight and symmetrical as the straightest growing variety. If you have a crooked young tree, try it. Beautiful straight trunks, with soft, smooth bark and beautifully formed heads, are some of the attractive features of the Paragon Fruit Farm.

But I do not approve of slitting for bark-bound trees; in fact, the orchardist has no business to have such trees, and if he has done his part intelligently they will not exist. But if he has them, the rational treatment is to scrape off all the dead bark and scales, then wash with some caustic solution, using a stiff hand scrub.

One of the best washes consists of one pound of caustic potash to five gallons of water. Wash the entire trunk and stricken limbs thoroughly. This destroys all fungi, lichen or moss, leaving the

bark clean, and it will soon become as soft and elastic to pressure as a soft cork. But care must be used in applying it. If it comes in contact with the hands or face, it is very caustic in its action and quickly eats through the skin, making sores that are very difficult to heal.

Several years ago, a friend seeing the smooth, thrifty bark upon my trees, asked how I kept them in that condition. I gave him the formula, cautioning him to get a brush with a handle and to wear gloves. But, alas, advice is too often disregarded. He, perhaps to save the expense of a brush and gloves used an old woolen stocking, and with his naked hands commenced washing his trees. The caustic soon put in its fine work, so he washed his hands, greased them and again went to work, but was soon forced to quit the job. When I saw him he was on the retired list, with his hands beautifully packed in cotton and carrying them in slings; his wife had to manipulate his buttons! The nails were nearly eaten from off the fingers,

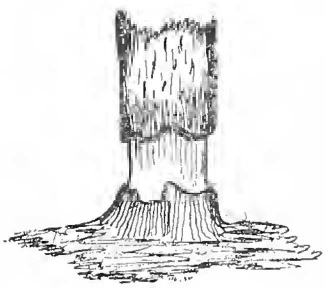


Fig. 33.
Girdled by mice.

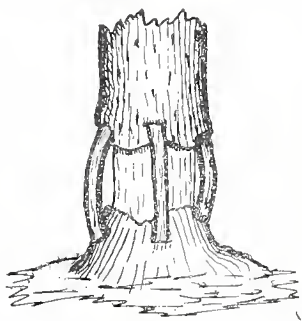


Fig. 34.
Bridge grafting.

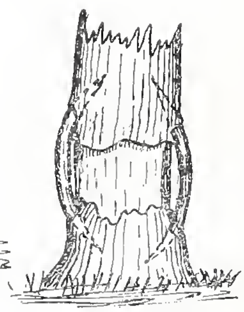


Fig. 35.
Showing direction of scion.

and each finger stood independent of the other, the skin between them being entirely eaten away.

When you have the bark-bound trees cleaned and washed, give them a nourishing diet; when a tree is making no growth and the bark is thick and hard, it indicates lack of nitrogen. This had better be applied in the organic form; a heavy application of stable manure being preferable, as it also furnishes humus at the same time and is a complete fertilizer. This is applicable to anything but the peach; here the mineral form is best. This will be further treated of under the heading, peaches.

Mice Girdled Trees may be successfully treated by mechanical means. Fig. 33 represents a young tree entirely girdled by mice.

If this tree were left it would perish, but it is easy to repair this damage, as shown in Fig. 34. It consists of merely fitting into openings made by a half-inch chisel, short pieces of round wood of the same species, properly dressed at both ends—the same as a scion

for grafting and fitting them into the chisel cuts. These cuts are made by placing the chisel, when making the lower cuts, nearly upright or slightly inclining outward from the tree, and then placing the point of the chisel upwards in a corresponding direction when making the corresponding cuts. The dressed scions should be a little longer than the distance between the cuts, that when they are slightly sprung and their points inserted, their tendency to straighten will firmly hold them in place. Fig. 35 shows the outline of these scions as inserted. The number required depends on the diameter of the tree. A tree of five or six inches in diameter, four or five will be sufficient. These wounds should be well protected with grafting wax to keep the parts from exposure. The scions will rapidly enlarge as the tree grows, and in a few years will en-

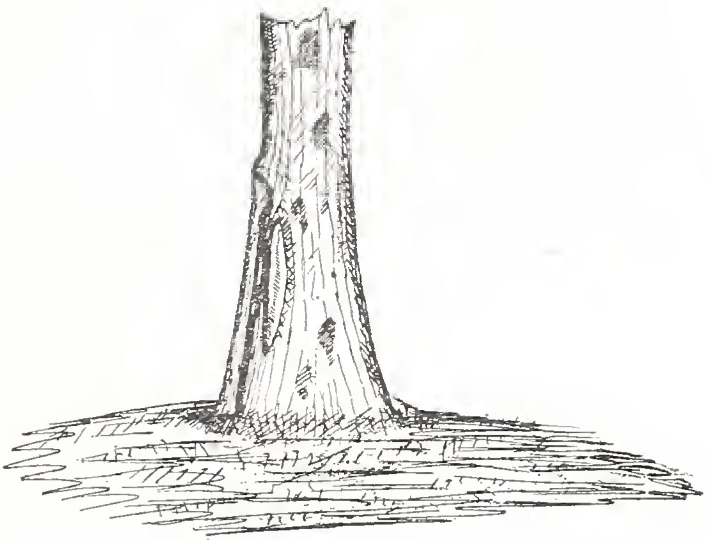


Fig. 36. A sucker inserted above a wound caused by the bursting of the bark by winter freezing.

tirely enclose and cover the wound. Fig. 36 shows a drawing of a young tree in the Paragon Fruit Farm, in which one side of the tree was badly damaged by Winter freezing; the bark parted, leaving a large open wound, a sucker came up near the trunk; this was inserted above the wound and the union as seen was perfect. The inserted sucker is growing rapidly and will eventually unite with the tree its entire length. But the best treatment is the preventive one; not giving the mice the opportunity to girdle them. This can be done by several means, all of which are effectual. 1. By keeping the ground free from all rubbish, by clean culture, etc. Mice never harbor in clean ground, as it affords them no protection for their nests and runways, likewise nothing upon which to subsist. 2. If the orchard is in sod and mice present, they can be poisoned by soaking corn or other grain in some poisonous solution and dropping

the poisoned grain in their runways; but here caution must be used or chickens or birds may be poisoned. 3. By cleaning a space away from around each tree a yard or more, and in Winter, when a snow falls, tramp the snow down around each tree. 4. The remedy resorted to on the Paragon Fruit Farm is to clear away a space from each tree and make a mound of earth, coal ashes or any other substance that will pack tightly by tramping. Make the mound about eight inches high and eighteen inches in diameter. The mice avoid the closed space, and when the ground is covered with snow and they extend their runway, when they come to this small hillock they invariably go around it. I have never had a tree injured by mice since I have stopped this method. Its purposes are two-fold. By leaving these mounds around the tree in the Spring, the apple tree borer inserts her eggs in the trunk of the tree just above the mound, and as this is several inches above the roots, by the removal of these mounds in early Fall it brings the work of these little pests in plain view, they can then be removed without having to dig away the ground around the roots; the work is much more easily and satisfactorily done, in half the time, and the roots never injured. Some writers say, why not paint your trees to prevent mice and borers? In theory it is all right, but practically it is worse than useless, as it throws the orchardist off his guard, he, thinking it will be effectual, does not look after his trees, and they are often ruined before he detects their presence.

Girdling for Fruit.—Taking advantage of the fact that parts of plants, vines or trees, imediately above the girdle become congested, shows that those parts are overfed, that is, that they receive more nutriment at the expense of the portions below the girdle; thus, by girdling, we can increase the size and hasten the maturity of the fruit which is borne beyond the girdle. The girdling of grapes is a common practice in some sections, where a specialty is made of raising fancy fruit. In the girdling of grapes, the girdled parts are entirely removed in the next pruning and enough of the growing portion is left below the girdle to maintain the roots, trunk, and produce bearing vines for the next season. There is, therefore, practically little liability of injuring the vitality of the vine; it being a mere question of how much is left below the girdle and how much above it. Keeping the vines properly balanced, the practice can be indefinitely continued. The girdling is done when the grapes are about the size of peas; a section of bark about an inch wide is entirely removed from the cane. A week or ten days may also be gained by this process. This also holds good in some other fruits.

A few years ago, in the peach orchard of Mr. J. C. Saylor, of Montgomery county, a Crawford late peach tree had one limb tied up. The string formed a stricture, interfering with the circulation;

the part above the stricture increased in size; the fruit ripened a full week in advance of those on the remainder of the tree and were fully again as large; but this practice would not be as satisfactory with the peach, for in pruning we could not remove all the limbs, without throwing the tree seriously out of balance.

Apple, pear and other fruit trees are sometimes ringed or girdled to bring them into bearing. Many orchards on fertile soil develop an extra amount of wood at the expense of fruit; by ringing, this rampant growth is checked and the tree is thrown into fruiting. We frequently see a tree that is seriously injured by borers is thrown into heavy bearing; seeding down the orchard has, to some extent, the same effect. We frequently see a tree hanging full of horseshoes and nails driven into the trunk, the owner claiming it made the tree productive, and he was right, for, by checking the growth of the tree it produced fruit. But this is too often done at the expense of the tree, for the injury done by driving nails, etc., into the trunk can never be fully overcome. As a general rule these stringent measures are not to be recommended, yet I would not hesitate to resort to ringing for special purposes. On the Paragon orchard, when we plant or top-work new varieties the qualities of which we are not familiar with, we frequently ring a branch or two, to bring it into quick bearing; then, should it not come up to our expectations (or rather the originator's recommendations) for experience has proven to us that the introducer is not apt to underdraw, but gives these candidates for public favor, more praise than their merits call for, we can regraft to some standard variety and thus gain several years in time.

Ringing can be done in more ways than one. We often see where this ringing has been done by the tendril of the grape twining tightly around a twig, thus effectively ringing it and bringing it into fruiting before any other part begins bearing. This has taught us we can do the same thing, by taking a piece of annealed wire and twisting it tightly around the limb or limbs, or even around the trunk; as the tree grows its diameter increases, the wire soon becomes partly imbedded in the bark; the descending sap is choked, and wood growth ceases and fruit buds become developed. But we must watch the ligature; it will become so deeply imbedded as to permanent injure the tree. When it has been on long enough to accomplish its ends it should be loosened, or better, be entirely removed. Another method, and the one adopted at the Paragon orchards, is to make an incision with a sharp knift entirely around the limb and deep enough to cut through the cambium, a quarter of an inch from this make another cut parallel with the first one; make a cross cut through this narrow strip: loosen the end and remove it, leaving a narrow channel clear around the limb. If this

has been done at the proper time, in the beginning of June, the bark will part so readily that the cambium will not be in the slightest injured, and healthy granulations will be at once thrown out along both cuts. A new bark will soon form from the uninjured cambium and the limb will be none the worse for this slight surgical operation. But the object for which it was done has been attained, by cutting through the cambium the free circulation has been impeded; the granulations formed a stricture, and before free circulation was again established, fruit buds have been started, and the following season you will almost invariably see the color of the fruit. In performing this operation some remove a strip of bark, two or three inches wide; but this is unnecessary and often injurious, such a wide strip of cambium is exposed that it frequently gets injured, it may be from insects, it may be from the hot sun; whatever the cause, if this in injured, it fails to develop bark, leaving wide breach of exposed wood; this fails to heal, and the limb will break off or die from starvation.

Healing of Wounds.—Before leaving this subject it might be well to mention a few other wounds beside girdling, and the treatment they should receive.

Body Wounds from Stem Blight.—These may be treated nearly similar to girdling. The diseased parts should be cut away to sound tissue, dressing the edges neatly; scrape out any decayed wood, and wash the parts with Bordeaux mixture, or some other antiseptic; then cover with wax. If the decay is now checked and the germs of fungi destroyed, the healing callus will soon cover the wound. The same treatment applies to sun scald, gnawing of horses, loose bark, and the like.

The sweet cherry is very susceptible to injury of the trunk from winter freezing, and scalding sun. In severe weather the trunk sometimes splits to the heart; if this is neglected, the bark rolls back, the wood becomes lifeless and tree soon dies. But if, as soon as discovered, when spring opens, the bark is trimmed back to sound, live bark, and the area treated with Bordeaux mixture, all is done that is necessary. In the cherry there is a strong tendency for the bark to roll back; in such cases, it is advisable to bind the wound with cloths, having first covered the parts with melted wax to keep them soft. The most difficult wounds to treat, are rotten cavities, so often made by careless pruning. In some instances the decay has gone so far, that it cannot be checked. The best treatment is, to remove all decayed parts, and then close up the cavity. Cut out all rotten and discolored tissue with a knife, or bore it out with an augur, and drive in a plug to lightly fill up the hole, having first soaked the parts with an antiseptic; paint the surface, trim the edges of the wound to live tissue and leave nature take her course,

TILLAGE AND MULCHING.

Webster defines tillage, "the operation, practice or art of tilling or preparing land for seed, and keeping ground in a proper state for the growth of crops." The earth is stored with a never-ending supply of potash, phosphoric acid and other mineral elements necessary for the growth and maintenance of vegetable life, and it is the province of man to assist Nature to make these elements available in larger quantities than Nature, unaided, is capable of doing. Through the chemist, the farmer and the horticulturist is annually becoming better equipped to take advantage of the forces that exist. We owe much to the work of the experiment stations in developing and bringing out the great fundamental truths and secrets that underlie successful farming.

Cultivation is the keynote of success. By understanding the proper combination, by cultivation we are enabled to unlock the great storehouse of Nature and get at her richest treasures. But what is the first number of the combination; where shall we begin? With the man; cultivate, spray and prune him first, then the orchard.

In horticulture, the man who makes a success is the one who learns the lesson of failures. He studies, he analyzes, he gets at the cause. He does not believe in the signs of the moon, whether in the new moon, the full, or the dark of the moon; whether in the sign of the posey, scale or the crab. What is by the ignorant termed luck, he knows is more apt to be the result of study, industry and perseverance. Loss may come in spite of our efforts, but we should not consider it necessary or incidental. Nor should we be content in this day, when intelligence counts, to merely guess at things; nor should we be too busy or indolent to set about tracing failure to its causes. Met properly, failure becomes success. The chief element of success, or failure in the orchard, is the man. The planter is too often ignorant of the reason why he does things. How can success be assured as long as guesswork or chance is his guide. To do a thing intelligently he must know when to do it, how to do it and why he does it. When these are understood, he works in harmony with Nature.

Ask the average farmer why he cultivates his corn, or his potatoes, and he will tell you to kill the weeds, or he may tell you the crop grows better when it is worked. Ask him why, and he will tell you he does not know. When his corn is suffering during a drought, ask him why he does not cultivate it, and he will tell you it is too dry, it will injure the crop. To him, capillarity is a dead language. He does not know that shallow culture, making a dust mulch, conserves moisture. He further displays his ignorance by plowing his corn and potatoes, by running through with a plow, tearing off thousands of feeding roots, and uncovering thousands

more by removing the soil from the space between the rows, and edging it up against the growing crop like a barn roof, which, instead of absorbing and holding the rains for the growth of the crops, turns it into the gutters thus made, and it is carried out of the field and lost to the crop.

The study of the soil, and the effects tillage have upon it, opens up one of the most interesting chapters in history. The subject is all the more suggestive because it is such a commonplace and almost universal labor that no one thinks of it as having a history. There is nothing new or startling about the stirring of the soil; it has been slowly evolved, like all other metheds and institutions, not within the last decade, but through a long period of time, and as a result of many forces, which, though felt, were unobserved or even unknown at the time. We can scarce trace back to the time when it was not a custom; and if one considers the condition of farming at the present time, he would seem to be warranted in such an association, for a custom is a habit, which is not suggested by thought, reason or inquiry. Perhaps the only reason people could give for cultivation of the land is that they are obliged to do it. They have been taught that it is necessary. Tilling the soil is one of the most simple occupations. It is simply the holding of the plow while it is being drawn by the team through the soil, lifting, crushing, inverting and fining, or by the manual use of the spade, hoe or rake. When one classes tillage only as labor, then the view is more or less correct. The work must be done because the plants grow better when it is done, but the less there is of it to do, the sooner it can be done and the easier it can be done, the better. From the earliest ages, without doubt, and even at the present time, tillage has been looked upon as a necessity, forced upon man by an unsympathizing, ungenerous Nature. Tillage was beyond doubt brought into vogue from the necessity of breaking up the soil to get the seed into it, and the second step was also a compulsory one, to remove and destroy the weeds that grew amongst the planted crop, and the third act was to dig to get the crop out of it. These three necessities served to bring the soil into and keep it in a state of subjection, and it was eventually observed that there was something in the practice that caused the plants to grow, aside from the lessening of the conflict with weeds. But it is only within the past century that there has been any great efforts made to discover why the stirring of the soil has proven so decidedly beneficial to growing plants.

One reason why the art of tillage has made such slow progress is because it seems to be contrary to Nature's method. It is frequenty advocated that the proper way to plant and raise an orchard is to plant so thick, and allow the leaves to litter the ground with-

out in any way disturbing the ground, as we find in the method of the forest. The forest lands increase in fertility from year to year, and the moisture is held as in a sponge. This reasoning is plausible. There are two ways of testing it—by experience and by reflection. It needs only to be suggested that the experiment has been tried, and is now being tried upon an extended scale, as a large proportion of the orchards of the country testify. The chief beneficiaries are the bugs, mice and fungi. The reason why the forest method is successful there, is because the trees stand so thickly that the earth is protected from the drying effects of the winds and sun. The forest covering is so extensive as to produce a climate of its own; all the product is returned to the soil, and there is no haste, no waste. In every essential the orchard and the forest are unlike. Those writers who advocate thick planting of orchards to imitate the forest condition, should also make it clear how the insects and fungi are to be kept under control, or how acceptable fruit can be obtained from trees that are unpruned, unthinned or unsprayed.

The objects to be obtained in the forest and in the orchard are wholly unlike. In one case it is the perpetuation of the species, and there results a severe conflict for existence, in which more trees die than reach maturity; in the orchard it is the securing of an abnormal product of the tree—a product that can be kept up to its abnormal or artificial development only by abnormal conditions, and the struggle for existence is reduced to a minimum, for it is desired that not one single tree be lost. It is simply because it is impossible to imitate the forest conditions, that the forest method cannot be followed in the orchard.

If we cannot have the protection of the forest cover, and the forest mulch, we must make the mulch for the occasion. Now that we understand why it is that stirring of the soil makes plants thrive; we must till for tillage sake, that we may unlock the granaries of the soil more rapidly than Nature does, and not wait to be forced into the operation by the growth of weeds and grass. But the weeds have had their mission, and they have fulfilled it; they have been a blessing to mankind, and we should remember them kindly for the good they have done to the race by holding us to our duty whilst we did not know what duty was; and they still stand ready to extend a helping hand. We should, therefore, not despise and condemn them when they strive to perpetuate their species. Were it not for their kindly office, with man in his grasping efforts to take everything from the earth and put nothing back, the soil would have become so impoverished, so hard and impenetrable, so dead, that the present and future generations would be unable to subsist.

Let us examine into the methods and principles through which tillage aids us in fruit growing. It improves the physical condition of the land, improving the texture, which we find is of as much, if not of more importance, than mere abundance of plant food. The crops raised are not dependent wholly upon a super-abundance of fertilizing material contained in the soil; it must be available; the soil must be in that fine physical condition that the roots of the plant can penetrate and have greater feeding facilities. By tillage we increase the depth and give a greater root-hold and foraging area to the tree or plant. At the same time we give it a greater capacity to absorb and retain moisture. It penetrates freely when the soil is in the proper condition; heat is also absorbed, and these three forces, when combined, are the most powerful agencies under Nature's control. Even the solid rocks cannot resist their wearing, corroding influence, but gradually yield, their hard surface gradually softens, and locked-up fertility is set free. Rocks contain various plant foods in abundance; even the apparent barren waste is full of plant food, and it should be the first effort of the planter to make this store available to plants. What though the key be rusty for want of use? It can soon be scoured and used to unlock the inexhaustible treasure that hath lain hid for centuries in the bowels of the earth.

Moisture is oftener needed during the growing season than fertilizers though both are essential if large crops are to be secured. Drought is looked upon by the average farmer as one of the incidental evils or calamities that befall us periodically, and the lesson of the recurring droughts has not yet been learned by the great army of farmers.

Pennsylvania has an average rainfall of forty-three inches, amply sufficient for all the needs is that the largest crops of fruits or vegetables. The great difficulty is that the largest proportion of this immense amount of water, 1,248,720 gallons per acre, comes at times when it seems not to be wanted, and the ground is not in condition to receive it. It runs off into the brooks and rivers; very much of it is permitted to pass off by evaporation. The truth is, the heavy rainfalls usually come during the Autumn, Winter and Spring, during the period of activity, when the work of the farmer and the growth of the plants are but little interfered with. In their short-sightedness, the majority of the farmers permit this great waste year after year, trusting in the Lord sending rain when the drooping crops need it. Indeed we are so blest with ample rainfalls during the growing seasons, that we are apt to speculate upon having rain when needed, and, therefore, neglect saving the early Spring rains.

To this we atribute partly the great success of the Paragon Fruit Farm. This water is carefully husbanded, and the trees and fruit never suffer. How shall we save the water? By converting the earth into a great reservoir, that it will hold back in times of plenty, and yield it up to the growing plants in time of need. If the earth is finely divided and yet compact, the capillary pores and interstices will hold enormous quantities of water. If then we break up these interstices next the atmosphere we prevent the water from passing off by evaporation. The whole subject of saving moisture hinges upon two means, the catching and holding it (or the making of a reservoir) and the prevention of evaporation.

How shall this great reservoir that shall hold untold millions of gallons of water be made, and how shall the distribution of water to the growing plants take place. Every acre of land in the farm or orchards shall be embraced within the area of the reservoir, and every foot of this same land shall act as the medium for the distribution of the water held within its own limited area. It is a matter of taking time by the forelock. The reservoir must be prepared previous to the rainfall. It is, therefore, a question of deep plowing and surface tilling early in the season, before the drought comes. If the land has not been well prepared, there will be no water to save by the time the drought comes. It will either have run away or evaporated long before the planter saw any necessity of saving it.

In many tracts hard pan is very near the surface. The water cannot penetrate, but runs off. Such land should be deeply plowed, to break up the hard pan, and to increase the storage capacity of the soil. If the land is open and leachy, shallow plowing is necessary, or the soil becomes too porous. Humus is an important factor in adding to the water-storing capacity. It absorbs and holds large quantities of water. There are many methods of conserving moisture, and the problem can in most instances be more satisfactorily worked out by the planter on his own farm.

During the Winter months, if the soil is well prepared, the water from the rains and snows percolates slowly but deeply, or if the soil is covered with any mulching or cover crop it holds back the water, slowly absorbing it. Some soils are greatly benefited by Fall plowing, to catch the water falling in Winter, also to expose the soil to the weather. Freezing and thawing have a very beneficial effect upon it, as well as by destroying myriads of insects. I would not advise the plowing of clay lands lacking humus, in the Fall, as they are apt to become compacted and cemented together, allowing but little water to penetrate. Orchards should never be plowed in the Fall; it is better to have some mulch or cover crop. This can be raised upon the land after the summer cultivation is

ended. Any body that is interposed between the soil and the atmosphere, will prevent evaporation of moisture. The importance of the proper attention to orchard culture is so great, that it deserves special consideration. As previously mentioned, the preparation of the soil should be thorough before the trees are set out, as after the trees are once in position, we never again have such complete control of the land as previous to setting.

Some might think, after reading of the thoroughness with which we prepare the land before planting, that it would be sufficient and that little future attention need be given; but let it be understood that this first preparation is but the prelude to the continuous attentions of a similar character. If the ground occupied by the young orchard is to be cropped for a few years, as is generally done, while the trees are small and occupy but a small area of land, it should be devoted exclusively to hoed crops, requiring constant cultivation and stirring of the ground. The corn crop is with many the favorite crop, as it is generally cultivated somewhat more than many others. Some also think the tall stalks afford a partial shade for the stems of the young trees. But with me it has never been a favorite. It is a voracious feeder and requires an immense amount of moisture during the growing season. Its roots reach far and during a dry season drink in all the available moisture, to the detriment of the trees. My favorite crop is the potato, planting some early variety. I prefer the potato for the following reasons: 1, its period of growth is of short duration, occupying the ground for only about three months, during half of which time it requires weekly shallow cultivation. 2, its requirements in the way of food is somewhat similar to the requirements of the trees. If we wish to get large crops of potatoes, we must feed large quantities of the mineral elements. Potash especially is wanted in abundance. In order that there may be available food at all times we apply double the amount actually required to mature the crop, the surplus remaining in the soil as a constant feeder to the growing orchard. 3, the crop is one easily handled among the trees. It is low, and yet shading the ground amply. In addition to this, it is much more profitable; if the soil is at all congenial, and from 1,000 to 1,500 lbs. of high grade fertilizer, analyzing 4x6x12, is added, the yield should be not less than from 250 to 400 bushels of tubers per acre. 4, the crop maturing early, can be dug and the ground cleared by the middle of July or earlier, which gives ample time to sow some cover crop, such as crimson clover, or cow peas. The soil being in fine condition, with an abundance of fertility remaining from the potatoes, is in excellent shape for their growth, and while fitting the ground for their reception the trees get the benefit of a good cultivation at just

the time they should have their last working. They respond to this generous treatment by making a vigorous healthy growth, and by Fall, if you have sown crimson clover, your ground meets the Winter conditions with a perfect mat covering every portion of ground, protecting it from exposure and leaching, and adding many dollars worth of nitrogen (the dearest element of fertility) that it has abstracted from the atmosphere. If cow peas are sown, by Fall you will have a mass of vegetable matter from two to three feet high and so thick you will be surprised. For Pennsylvania, the Whippoorwill variety is one of the best. It will continue growing until cut down by the frost. Leave this lie on the ground as a Winter mulch; it will protect your soil, and by Spring the snows, the rain, etc., have beaten it down and broken it and it plows under nicely. It belonging to the family of legumes, has also added a large amount of nitrogen without costing you more than the price of the seed. The humus and nitrogen added to the soil will be fully equivalent to ten or twelve tons of good stable manure per acre.

By this method an orchard can be quickly and cheaply raised, and instead of reducing the fertility of your land, you are continually storing up a reserve for the future feeding of the trees. I am fully aware that a great many object to this method. They lay great stress upon the injurious effects of the crop, that it robs the soil of so much fertility; that the trees need the entire area; and perhaps with those who thus reason, the theory may be correct, for many think it false economy to feed a plant more than its actual needs require, that the surplus will be lost. If there is no growing crop we will admit that there will be a loss in nitrogen, but by our method there is a growing crop to take up and utilize available plant food, which it later returns with interest for the use of future crops, or in the case of the cow peas, we have a mulch during Winter, covering completely the entire surface, and any one familiar with the mulch system knows there is no loss of fertility from soil thus covered, but a constant increase. It is owing to the mulch of leaves that the forest increase in fertility. Some persons are induced to apply homeopathic doses of fertilizers for the immediate use of the temporary crop, counting upon an immediate return for the outlay. They are seldom willing to make any return to the soil in compensation for what they have removed from it. Any one thinking that they can thus defraud Nature and rob their soil, will soon have a painful reminder of their delinquency in the diminished productiveness of their fields and orchards.

Hoed crops should alone be allowed to occupy the space between young trees, and on no account should small grain crops be allowed until the trees come into bearing, and some fruits will at no time

in their existence tolerate anything but clean culture. Any planter expecting to raise the peach successfully in sod, had better donate his money to some charitable institution, when he would have the satisfaction of knowing that some one received a benefit therefrom. But there are many situations where the surface is too hilly for cultivation, yet they are admirably adapted to the purpose of raising fruit. In such places the tillage must be kept up by other means than the plow and harrow. The spade and the fork must here be relied upon to loosen the soil and with the garden rake a dust mulch can be made, or a mulch of any course, rough material can be used. Where manual labor is called in as a substitute for a horse, the expense is greatly increased, and where the area is large it is almost prohibitory. In all large plantations we must depend upon such implements as are drawn by horses, and do a large amount of work in a day. Preference should be given to such tools as are convenient to handle, adjustable to width and depth; such that stir and pulverize the soil near the surface only. Shallow culture of the upper layers of earth effects the objects in view better than deeper cultivation. The weeds are eradicated and the results are a fine mellow condition of the soil. The roots are not torn or bruised, but are encouraged to turn their feeding fibres into the soil's mellow stratum above them. Where the cultivation is kept up almost continuously, as at the Paragon Fruit Farm, where our peach orchards are cultivated from two to four times a week, the latest improved machinery and such as will do a large amount of work in a very short time, and have their framework very low, with levers lying parallel with the earth surface when in use, are very necessary. Our trees are all trained so low that the limbs, when laden, rest on the ground, so that high framed machinery, with upright levers, cannot be used, but with our low down harrows it is surprising how they will slip under the limbs, close to the trunks of the trees, and scarcely disturb the fruit. Does this not require a vast amount of labor and patience? Yes, but it is a labor of love, and the profits are great. Any man born tired, or who has no love for the beauties of Nature, who would rather sit at the smith shop, hotel or store, had better not engage in commercial orcharding.

MULCHING has some advantages over cultivation, but the serious drawback is to obtain the material. This is most cheaply obtained by the growing of green crops, or cover crops, the saving and using of that which has been grown as food for the new crops. For just as much as a grain crop, a green manure crop needs to be harvested, though in a different way. This requires an understanding of those chemical changes which plant food is believed to pass through in its transition from one crop to another, or of

the nature and causes of decay of vegetable matter in its transformation into food for growing plants or fruits. But if the remains of one crop are thus to be made to profit another, an understanding of this side of the question is as useful as an understanding of the cultural side, and much more difficult. It requires higher intelligence to secure to the fullest, the benefit of a green manure than it does to grow it. It is obviously useless to learn that a certain crop, which is to be plowed under, contains one hundred pounds of nitrogen to the acre, if we do not know how the nitrogen may be used by the new crop, or whether it will be used at all. The nitrogen contained in a green manure is in its natural state as useless for plant food as an unharvested crop is for human food. The one requires further management to make it available as much as the other. There are two component parts of the green crops grown as a mulch or cover crop to be taken into consideration, that which grows above ground and that which grows beneath the surface, and due consideration should be given to their comparative value. The remains of the plants left in the ground are beneficial to the land in two ways: First, by reason of their chemical composition, or as plant food properly, and, secondly, by reason of the physical condition they promote in the soil. Much benefit that is credited to the former is really due to the latter.

It must be emphasized that green manure in its present state is an absolutely worthless mass of vegetation, for whether we regard its chemical value or its physical effects on the soil, it is worthless in either aspect in its present form. Certain changes must take place before it can become available for either purpose. These changes, in their character and importance, far greater than in human nutrition the change from raw to cooked food, or from green fruit to ripe, are chiefly brought about, like the assimilation of nitrogen, by means of micro-organisms in the soil. That is, the soil must be such that not only agricultural plants grow in it, but also such that these micro-organisms, which recover and prepare food for plants, may thrive as well. A half century ago the opinion was that all crops would grow and thrive upon purely mineral food, such as potash, phosphoric acid and nitrates, and experiments have proven this to be true. But on the scale of practice it is not economically true, for decay, as we call it, is as much a part of the complete circuit of life as is growth. Food for the coming crop must be prepared through changes in the remains of former crops, and these changes, as are now generally believed, are due to micro-organisms, so that a most important part of the question of the quality of the soil is as to its fitness to support these microscopic forms of life.

It is not the intention to enter deeply into the nature of the

nitrogen-assimilating bacteria, as any one particularly interested along that line will do well to obtain bulletins on that subject, but our object is to treat of them only in connection with cover crop in orchards.

THE CHEMICAL VALUE OF GREEN MANURES.

The three principal mineral constituents contained in green crops, nitrogen, potash and phosphoric acid, are valued not because they are more necessary than other mineral substances found in the soil, as lime, magnesia, iron, etc., but because the latter class are usually present in sufficient quantities for all the needs of plants (lime being an exception, as we find land often deficient, and in such cases both tree and fruit is greatly benefited by an application to the soil) while the three first named are very seldom present in an available form in sufficient quantity. Of these three, potash and phosphoric acid are never added to the soil by the crop. All that the crop contains and leaves behind was taken from the soil itself, and merely restores that which was borrowed. With nitrogen it is different.

In considering the manurial value of potash and phosphoric acid in green manure, we have to do not with something gained, not with something added to the soil, as in the case of commercial fertilizers, but merely with a change of form that is more readily available. In the remains of plants potash is found in the form of a carbonate, which is soluble, and the phosphoric acid is combined with lime and other basis, though insoluble, yet it is in a form that can be acted upon much more readily by the roots of the trees.

The money value of a green crop is difficult to estimate. The value of a thing depends upon the need of it. But analysis tells us what, and in what proportion various crops contain these valuable elements. Then by multiplying this by the commercial value of each ingredient we get the comparative value of the crop. We find a crop of rye and vetch gives a value of about $25.00 per acre.

A crop of rape gives a value of about	$24.00 per acre
A crop of crimson clover value of about	22.00 per acre
A crop of cow horn turnips value of about	21.00 per acre
A crop of soja beans value of about	20.00 per acre
A crop of red clover value of about	18.00 per acre

It is surprising how nearly these crops compare in commercial value. Many might suppose that one might be just as valuable for a mulch crop as the other, but there is considerable difference in value. The legumes, such as the clovers, vetches, cow peas and soja beans, give back not only what they have taken from the soil, but large quantities of nitrogen (the most expensive element of fer-

tility required by the plant) that has been given from the air. But I think a great many writers give too large a credit to the source, for undoubtedly a large proportion of the nitrogen is taken up by the roots from that the soil already contains.

In figuring the value of the crop, tonnage, owing to the fertility greatly influences the amount of valuable constituents. A great difference is shown in the value of the roots. The cow horn turnip has about 42 per cent. of its value in its roots; alfalfa, 40 per cent.; red clover, 30 per cent.; while crimson clover, cow peas, soja beans, vetch and rape, have only about 10 per cent. of the total value in their roots. The potash is invariably richer in the tops, nitrogen likewise, except in the red clover. The phosphoric acid is nearly equally distributed.

After taking into consideration the value of the different crops, we come to the conclusion that the leguminous crops, the clovers especially, are the most valuable cover crops to grow as a mulch for the orchard. Foreign matter, brought from other sources, would be preferable, as it would bring additional fertility to the orchard; but the serious drawback is to obtain the material. People in close proximity to the great straw piles of the West, or the salt marshes of the East, have material in plenty that can be used to very great advantage, even the fallen fruit is seldom bruised unless it comes in contact with a limb in falling. But people removed from these vast sources of supply. must resort to other methods of obtaining mulching material; they must depend upon producing the clovers, the cow peas, or other legumes, which are generally raised upon the land itself, and mowed as often as required, leaving the product lie beneath the trees. A part of the Paragon apple orchards lie against a steep hillside, where for convenience in spraying and hauling out the fruit, we have graded roadways. This land cannot be cultivated and put to the legumes as the rest of the orchard is done annually, so here we must depend upon mulch brought from other sources. We use all the tobacco ribs we can get, at $2.50 per ton; we purchase stable manure in Philadelphia, and have it shipped by cars, costing us $2.25 per ton. One ton of manure will heavily cover the ground in a circle of twenty-five feet diameter, around five trees. This brings the cost per tree, including labor, a trifle over fifty cents. Does this pay? Can we afford this expense annually? Certainly we can, when we take into consideration that it is doing a dual work; it is mulching the ground, keeping it cool and shaded, preventing evaporation of moisture, holding it in reserve, giving it up as the tree calls for it . It is also by its decay adding fertility to the soil by furnishing humus and such valuable elements as potash, phosphoric acid and nitrogen. It needs but one bushel extra per tree

to pay this expense. Cannot you well afford to give one-tenth or one-twentieth part of the tree's product for food?

What proportion of the products of the dairy cow does it cost the dairyman for food? Of all the cows kept on the ordinary farms, not one-half produce sufficient to pay for their keep; the remainder will not average more than twenty-five to fifty per cent. profit. It takes cattle above the average that will pay their board and give their owner an equal amount to recompense him for labor and care bestowed upon them during every day of the year. On the average farm it requires three acres to keep one cow. If this cow is a good one she will give her owner a profit of thirty-five dollars. The same number of acres will support one hundred and five trees, that on the lowest estimate will give five bushels per tree (good trees will give from 10 to 25 bushels per tree) or five hundred and twenty bushels from the three acres, at fifty cents per bushel, will be two hundred and sixty-two dollars and fifty cents; allow the sixty-two dollars and fifty cents for spraying and harvesting the fruit, leaving two hundred dollars in hard cash. Compare dairying with ocharding, and figure out whether you can afford to expend fifty dollars of the two hundred for mulch and feed for your trees.

Mulching even of an old orchard, pays. The old devitalized trees quickly respond in increased vigor and productiveness. I well remember in my boyhood days, my father had an old tree long past its period of usefulness. On the impulse of liberality for the good it had done, he gave this old relic of prehistoric times a large cart load of good manure, with a cash value of about $1.50. This proved a veritable case of casting bread upon the waters, for this old tree became rejuvenated and produced annual crops of fine fruit for many years. Trees that are low-headed, with short trunks, and branches spreading, nearly touching the ground, need much less mulching than high topped trees, as evaporation is much less where the ground is constantly shaded and cool.

Shall we pasture our orchards, is a question for serious consideration. It has many things in its favor and many against it. All stock will trample and harden the ground. Low-headed trees will be seriously injured by horned cattle breaking and twisting the limbs, knocking off the fruit. Horses, likewise, pull the apples as high as they can reach, and frequently gnaw the bark from the trunks and larger limbs. Sheep are frequently put into the orchard with advantage, as they will keep down weeds and other growths that more or less interfere with the trees, but they will also spoil low headed trees and pull fruit as high as they can reach, by standing on their hind legs, also cleaning the lower branches of leaves, and they should never be turned into the orchard in Winter or any time when food is scarce, as they are very likely to attack and strip off all the bark they can get at.

The only animals that should be allowed free range in the orchard are swine and poultry. These will prove useful in the destruction of immense numbers of codling moth and other insects, that are particularly injurious to cultivated fruits, but if orchards are intended to be pastured even by swine, the branches must be trained higher or the animals will break the limbs in their attempt to reach the fruit; as we have our trees trained in the Paragon orchards, it would be highly injudicious to turn swine or any other animals in to pasture. As far as eating the falling fruit, the benefits would be great, in keeping down the insect pests. But we find by spraying as we do, the insects are kept at a minimum. Comparatively little fruit falls; but were it not for the incompatibility of the swine and low-headed trees, we certainly would combine the two, as they are the greatest scavengers we have. They are also great economists, for after feeding upon the grasses and weeds, they consume the fallen fruit for dessert, and nothing is wasted; even the codling moth are converted into pork.

The plum orchard is particularly benefited by chickens. Very few of the little turks are enabled to escape the sharp scrutiny of the mother hen and her brood of young chicks, that are on the constant lookout for such dainty morsels. But there are none of these aids that can be alone depended upon. We must be wide awake, vigilant, always prepared to strike when needed. And the importance of cultivation in the young orchard cannot be too strongly impressed upon the orchardist, nor can he exercise too much care in avoiding injury to the stems and roots while practising this constant culture of the soil.

What effect has cultivation upon fruit? Thorough cultivation and high fertilization shows its effects upon the fruit by increasing the size at the expense of color and flavor. We always get the largest specimens from young cultivated, thrifty, vigorous growing trees; but the quantity is not so large, for as stated in a previous chapter, when a tree is making a very large wood growth it does not produce so many fruit buds. Young, thrifty trees have a very large number of leaves, making a dense, heavy shade, through which the air and sunshine cannot penetrate, and though the fruit growing of such trees will attain maximum size, as fruit always grows larger in the shade, it requires a slower growth, free access to sunshine and circulation of air, to develop in the highest degree the rich aromatic or spicy flavor we so highly appreciate in the apple, and the intermingling of the beautiful tints of varying colors that add so much to their attractiveness.

Cultivation is the more important, because the orchard needs constant attention for years; and in ordinary practice it receives the greatest neglect. For of the thousands of trees that are annually

planted throughout the country, how many receive the attention that self interest should induce the planter to give. It is asserted, and I believe truthfully, that more trees die from neglect after planting than from all other causes combined. Too many, after purchasing their trees, set them out unpruned, into uncongenial, ill-prepared ground, then, feeling they have fulfilled a duty to themselves and future generations, they turn them over to the tender mercies of Nature. Thus left, the sun and high winds dry out the soil, weeds and grass grow up and choke them, and they die a slow and lingering death. Or if they live, they maintain a stunted and feeble existence, like half-starved cattle of a neglectful farmer. Then the nurseryman is upbraided for defrauding him.

TOOLS NECESSARY FOR THOROUGH CULTIVATION.

A good mould-board plow is one of the essentials for breaking up, pulverizing, and turning the soil, for the turning under of coarse manure, weeds, grass, etc. a drag or spike harrow; the most convenient are now made in sections, one, two, three or more can be attached together, covering a very broad strip. These are controlled by levers, that the teeth can be set at any angle required. When used (as they often are) as a pulverizer and smoothing harrow, the teeth are thrown back at an angle, when depth is required they are set straight. This harrow is used more on the Paragon Farm than any other tool. We have them of the proper width, that one passage between a row of trees cultivates the entire space, thus economizing time, and cultivating close to the stem, while the team passes in the middle of the space without interfering with the branches.

A Spring Tooth Harrow on Wheels.—This is the first tool used in the Spring in our peach orchards to loosen up the soil, instead of the plow. We prefer it, as it never ridges or leaves a dead furrow, and by going lengthwise and crosswise it does complete work and loosens the soil as deep as required. Then you can loosen the soil within six inches of the stem of the tree, which cannot be done with a turning plow. For this purpose we separate the two sections of the harrow and place a steel frame between them, thus spreading them to any width required. Thus adjusted, we harrow once around each row in each direction, the harrow passing under the low limbs. Any blacksmith can make this frame, also have him bend the levers so they will lie parallel with the earth surface. After the trees are harrowed in both directions, remove the frame, place the sections in their original position and harrow the middles in each direction. Your soil will now be broken up to the depth of three or four inches; deeper you do not require it. The balance of the season the drag harrow will be used exclusively, twice to

four times a week, and after each rain. Never leave a crust form; keep a dust mulch on the surface all the time.

While the orchard is young, and cultivated crops are planted, a two-horse riding cultivator, one having a stiff, rigid frame, easily controlled, will be found very convenient. We are using the Planet Junior Double Row Cultivator. It works easily, and responds instantaneously to the slightest foot pressure.

A one-horse adjustable wheel cultivator will often be found of use. The Acme harrow is an excellent tool for pulverizing the surface, that has trash; it does not pull it up or drag, but buries it and leaves the soil in good shape, in soils free from stone and not too hard, the Disk and Cut-away harrows are all right, but on the Paragon Farm they are laid aside, as we find it impossible to do satisfactory work, having a great many small stones to contend with. There are other special tools made for orchard culture that doubtless do very satisfactory work.

Swingle-trees of different lengths, from 15 inches up, should be on hand in plenty; also suitabe double trees. Muzzles for the horses, as many a fine tree is ruined by the horses being unmuzzled. Grubbing hoes, picks, shovels, forks, all should be on hand, and good ones. A poor tool of any kind, for any purpose, is an expensive article to have around. A kit of tools, saw, square, hammers, hatchets, augers, brace and bits, chisels of all sizes, different size bolts, screens and nails, should be on hand. Many a trip to town will be saved in busy times. Handy and suitable wagons, broad track wheels for heavy hauling, a lighter one with $1\frac{3}{4}$ or 2 inch tread, for light hauling; a good covered express wagon, with the best oil tempered springs for hauling fruit. Never attempt (as is so often done) to haul your fruit to market or even from the orchard to the buildings on a wagon without springs; its keeping qualities are ruined, and its market value reduced. Other tools will be mentioned under the head of picking and packing.

THINNING.

There is no work in connection with fruit raising that pays so well for labor and money expended, as thinning. Reducing the number for the purpose of improving that which remains is a practice which should always be advised, but advice is one of those things costing nothing, is liberally given, and seldom followed. If the fruit raiser can once be induced to thin his fruit, he will in the future continue the practice. It not only results in much finer product, but it is also a means of destroying diseased specimens and those infested with codling moth and fungi, and of saving the energy and vitality of the tree. What makes it prohibitory in general, is the labor and expense. We will admit it is a matter of considerable expense, but

is it not the same with almost everything we undertake; if we desire to produce something above the ordinary, it requires extra effort, so if we wish extra fruit annually, we must thin, and there is no reasonable excuse for not performing it. With a little consideration, we find in the end that the expense is not so much greater. All of the fruit must be picked some time, and it does not cost as much to pick it off early in the season, while it is small, and we need expend no extra care in the handling of it at this stage. It can be dropped to the ground, whereas, if left until maturity, all must be handled with much more care, hauled to the packing house, again be handled in assorting and a great deal of it will then be thrown out as culls, which, had it been properly thinned, might have given fine marketable fruit. There are two methods of thinning fruits; one is a matter of pruning, by means of which the superfluous branches are removed, or even the fruit spurs themselves, where they are too thick; the other is the direct picking off of the over-abundance of fruit.

Every person at all familiar with trees and their fruits, are struck with wonder upon looking at their fruit trees in Winter, to see the profusion of fruit buds. Every little slender branch of many varieties is as thickly studded with fruit buds as a necklace of beads; they are crowded together in clusters upon every fruit spur. Any one familiar with the Burbank plum, upon looking at it when in bloom in May, cannot but wonder at the great profusion of Nature. Every twig and limb will be one continuous rosette of blooms completely hiding the twig that bears them, and we ask why is this great waste, why is so much energy expanded and vitality lost in developing such immense numbers of bloom that the tree cannot bring to maturity one-tenth of them. But rest assured that this is but another evidence of the unerring wisdom of Nature wherein all things are done for the best.

In Nature, the object is reproduction or the perpetuation of the species. Every tree and plant, sooner or later, reaches a point we call maturity. It has reached that stage when Nature demands that it perform the functions required of it. In many plants this takes place annually. These are called annuals; they produce the germs of perpetuation (seeds) at the expense of the life of the plant. As seed is produced and comes to maturity, it gradually abstracts all the vitality from the stock and roots, and stores it up in the seeds, and the plant dies. Many of our grasses, cereals, and tubers belong to this class. Some plants live two seasons and produce their seeds, then die. The common red clover is one of these. These are classed bi-ennials. There are others that continue indefinitely, producing seeds annually. These are classed perennials. Under this head comes our fruit trees, but when they have reached the proper

stage of maturity (and this may be lengthened or shortened by the environments) a great change takes place. Conditions have changed, and those buds that would have otherwise produced leaves and wood growth, are changed into fruit buds. The same elemental parts are still present; but those that were arranged for the production of an elongated shoot, with leaves set around it in a definite manner, and destined for the formation of woody growth, are now so constituted as to make a very short growth, and a modification of leaf formation, and the leaves are clustered and crowded around this shortened axis. Here we have a lesson in the interesting study of evolution, in the production of flowers and fruit from what were otherwise the source of shoots and leaves.

When the plant is young, its chief object is to grow; it must acquire size and development to enable it when at the proper age to produce and support the enormous crop it is destined to yield. Hence, in the early years there is very little of this transformation of the buds, which are all of a pointed character, and when excited into growth they all produce shoots and leaves only, which results in the formation of an increase of the woody fabric, that we call tree. This period of adolescence is longer or shorter in different species and varieties, often extending through many years. Thus, in the century plant it requires a great many years. It is claimed that one hundred years must elapse before it reaches this stage of maturity, to blossom and produce seed. But this is erroneous; when climate and soil are favorable they come to maturity in less than one-third of that time. I had the pleasure of watching one of these interesting plants developing. The plant was but thirteen years old, but of immense size, standing from eight to ten feet high, with a spread of twelve feet. Early in the Spring we noticed an unusual growth starting out in the center. In appearance this resembled a huge asparagus stock. It grew rapidly, from eight to twelve inches per day, in length, in stem diameter it did not materially increase; it was a trifle over eight inches in diameter from the start. This rapid growth continued until the stock measured twenty-one feet, when laterals made their appearance. From this time the main stock did not make such rapid growth, owing doubtless, to its forces being divided, but growth continued, with additional side branches, until the entire stock measured a trifle over thirty feet. The branches were from three to eight feet long. On the upper side and at the end of these branches were a large number of leaves in clusters, each one a perfect plant in itself. From these there appeared in a short time, medium sized, unattractive yellow flowers, which in turn gave place to seed pods, almost two inches long by one inch in diameter. These were full of black seeds. The stock died, but the young plants growing upon

the limbs retained life for weeks; when these were set in the ground they struck root and gave new plants.

There is probably a definite time, under proper conditions, when each kind of fruit will have these changes occur in the buds, when they will begin to flower and produce fruit. This period can be accelerated or retarded by human means, as we notice that anything that produces excessive vigor retards fruiting, and anything that checks this vigorous growth, provided it does not too much impair the vitality of the tree, will conduce to the formation of flowers and fruit. The methods by means of which this is done has been treated of in another place.

To keep the proper balance between the two systems of growth requires very careful attention upon the part of the planter. Two opposite systems of production have become established in the tree; the one to preserve the health and vigor, the other tending to preserve the species, at the expense of the tree, for old trees are apt to overbear. Young trees, on the contrary, frequently bloom but fail to set fruit, owing perhaps to some imperfection of the organs, or drops prematurely in consequence of the wood growth absorbing all the nutriment, or failing to prepare the proper juices for their support. Trees in these different conditions require entirely opposite treatment. The younger need summer pruning and pinching to check their vigor, and develop their laterals and spurs The older need Winter pruning, for the double purpose of reducing the bearing wood so they cannot overbear, and to excite renewed vigor in the production of wood growth. I trust the reader will pardon this partial repetition, but it is a matter of such importance in the economy of fruit production that it should never be lost sight of.

Thinning fruit is too much neglected, or its importance has never been sufficiently instilled into the minds of the average fruit raisers. This is particularly so with the apple. Old trees are often so fruitful that the fruit is not only so deteriorated as to be almost worthless, but the tree itself is injured. This is so much so with certain varieties that it constitutes a serious objection to planting them; other varieties so exhaust themselves by overproduction in one season, as to be barren the next year, during which period of rest they recuperate their energies and produce a new set of fruit buds. These are called biennial bearers. The largest proportion of our leading varieties are classed under this head. Not that they naturally belong there, but the ignorance of the owner, not understanding the natural laws that govern them, has placed them there. Those kind that are prone to overbear are objectionable on account of their small size and inferior quality, for when a tree is loaded beyond its resources, it cannot furnish nutriment in sufficient quan-

tities to develop either the natural size or flavor. These varieties should not be planted by those who are too painfully economical to expend a few cents upon thinning the fruit from the tree, and who are too shortsighted to see the future benefits. The great desideratum, especially with those who object to the trouble of thinning the fruit, is to find varieties that will produce well distributed and continuous crops, annual bearers, those that never overbear and thus exhaust themselves by over-production. Such varieties are uncommonly few under the present management of the average orchards. They should be and are plentiful in orchards that are receiving later improved or rather modern intelligent treatment. Nature favors, and the trees are willing to do their full share and even more, and it is their willingness, and man's indifference, that throws them out of balance and produces the so-called off-year, an unnatural and abhorrent condition with Nature. She makes strenuous efforts to overcome the condition. In years of over-production, when the tree is burdened beyond its capacity in developing its fruit, in obedience to the laws that govern the animal and vegetable kingdom, it produces buds for next year's bloom, and when the season arrives the flowers open in all their beauty, apparently as perfect as those of the previous season, but this is the end of their existence. The calyx fails to expand and shortly after the petals drop, the embryo fruit drops also. Why is this? We are informed that it is the off-year, or that the season was unfavorable for polination, whereas the truth is, the energies of the tree were completely exhausted. It could not store up any reserve for the future, therefore when the bloom opened, there was not sufficient vitality left to develop the embryo fruit.

There is no reason in the nature of things why trees should not bear every year; but the formation of the fruit spur is usually such as to preclude the production of fruit upon the same spur every year. The philosophy of the thinning of fruit on such trees as produce their fruit on spurs is, therefore, that one spur shall bear one year and another spur the next. This means that in thinning, the fruit should be removed wholly from some spurs in order that they may produce fruit-buds for the following year. In orchards where fruit is systematically thinned the crop is uniform and regular. The Sunnyside and Paragon Fruit Farms have had no off-year in thirty odd years, or during the period of their existence. Why? Because they were properly pruned. systematically thinned, until the regular bearing habit was established, and sufficient nutriment required for the best development of stock, branches, leaves and fruit has been given at all times, and the fourth requisite, spraying, has been faithfully performed for many years; if to this you add culture, you have the keynote of successful fruit raising.

At the Paragon Fruit Farm systematic thinning is one of the essentials that is never omitted. If from any cause, financial or otherwise, any one of the duties we hold sacred to success, would have to be omitted, thinning of fruit would be one of the last to omit, as we think, and past experience has proven it to be, one of the most important duties we have to perform.

It is certainly a task that tries the courage and nerve. It is a task I seldom perform myself. I put my force at work at the proper time, showing them how, the proper space to be given, etc., and leave to attend to other duties. I frequently return to note progress, and the condition in which the work is done; and on many occasions on seeing the trees apparently stripped, the ground covered with green fruit, I felt sick, and thought I must tell them to let up a little, but knowing the necessity of it, knowing that any let up would be detrimental to both tree and profits, I would feel compelled to leave the orchard for fear I might yield to temptation.

Thinning the fruit trees requires more discrimination and judgment than does the picking of the fruit, to get it at the proper distance, well distributed, leaving no two in contact, picking off all stung or imperfect fruit. Careless workmen frequently remove good, strong fruit, and leave a stung specimen, which ultimately falls, leaving the twig without fruit. I find intelligent women are the best for this business. They are quick, nimble with the fingers, and more conscientious workers than men. I frequently get a hand that would be more profitable to me sitting on the fence, away from the other hands. Any one who is an incessant talker —one who knows all the news of the neighborhood, had better be dispensed with or put by himself, as he detracts the attention of the others from their work, and thinning fruit requires the full combination of thought, eye and fingers.

As to estimate of the cost of thinning, so much depends upon the form of the tree, whether high or low, being much less where nearly all parts can be reached from the ground, or from a low step ladder; the amount of fruit to be removed, the character of the workmen, the price of labor; where intelligent women can be had at $1.00 per day of 10 hours, and the training of the trees has been on modern principles, and the trees are not overly large or full, from twelve to fifteen trees of four or five years of age will be a fair day's work. When peaches are full grown, with an average top diameter of twenty to thirty feet, from two to four trees will constitute a day's work, depending much upon the fulness of the trees.

One day last week I had five hands thinning my York Imperial apple trees, ten years old, with a top diameter of twenty to twenty-five feet, and an average height of fifteen feet. They were very

full indeed. Half of the work was done from the ground, the balance from step ladders ranging from five feet to eight feet. I suppose, on an average, a little more than half of the fruit was removed. At least the ground was well covered. These five hands thinned twenty-five trees in five hours, costing me ten cents per tree. Very large trees will cost from twenty-five to seventy-five cents apiece, but you will be amply repaid for time and cost. The proper time to thin, the time when it will be most beneficial to both fruit and tree, is as early as possible, as soon as the fruit has attained sufficient size to handle it, before the stone has hardened in the drupe fruit, or the seeds have attained their full size in the apple or pear. We prefer beginning with the peach about the tenth of June. By this time the June drop has done part of its work, and the fruit is large enough to show imperfections, stings, etc., and such fruit that will fall; by this time the fruit that will remain will be plump, well formed specimens, with stout stems connecting the fruit firmly to the limb. The time the fruit seems to be most exhaustive to the tree, is at the time the seeds are maturing, therefore, by removing the over abundance of fruit before it has reached this stage, we save the tree a large amount of vitality, a portion of which will be profitably used in enlarging the edible portion of the remaining fruit, bringing it to the highest state of perfection, size, color and quality.

The systematic thinning of fruit is a comparatively new departure in its production. One of the best investigations which has yet been undertaken was in connection with the Geneva Experiment Station, of New York, under the direction of S. A. Beach, in 1896. These experiments were made on full grown trees.

Trees of the same variety, as nearly alike as possible in all respects, were paired for comparison, one of each pair being thinned, the other left unthinned. Three ways of thinning were tried:

"First.—All wormy, knotty, or otherwise inferior fruit was removed, and all clusters thinned to one fruit.

"Second.—Same as first, and the remaining fruit thinned so that the applies were not less than four inches apart.

"Third.—Same as first and the remaining apples thinned so that the apples were not less than six inches apart.

"The sixteen trees which are included in the experiment belong to three varieties, namely, Rhode Island Greening, Baldwin and Hubbardston. The Baldwins were the most heavily loaded last season, and gave the most marked results in favor of thinning.

"With the first method, Baldwin, thinned, gave 16 per cent. less fruit, but about 10 per cent. more No. 1 fruit than did the unthinned Baldwin. With the second method, Baldwins, thinned, gave

26 per cent. less fruit and 22 per cent. more No. 1 fruit than did the corresponding trees which were not thinned.

"With the third method, Hubbardston gave 25 per cent. less fruit, but about 17 per cent. more No. 1 fruit than did the unthinned Hubbardston. The Greenings were very heavily loaded in 1895, and in 1896 they bore a good crop, but were not overburdened, and needed comparatively little thinning. They were thinned according to the second method, and 6 per cent. more fruit, and about 10 per cent. more first class fruit than the trees did that were not thinned."

In all these tests the picked fruit gave about one bushel of culls where the fruit was thinned, to three bushels where it was not thinned. Where the fruit was thinned the drops were fewer and considerably better, and in all grades the fruit was clearly superior in size and color to fruit of the same grade that was not thinned. The first grade included no apples less than two and one-half inches in diameter, and the proportion which measured two and one-half inches was a great deal larger where the fruit was thinned, than where it was not, so that No. 2 apples from trees which were thinned were much superior to No. 2 fruit from trees not thinned. It was estimated that the fruit from the trees which were thinned would bring from 10 per cent. to 15 per cent. more in market than the same grade trees that were not thinned. According to these results, the second method of thinning is enough superior to the first to more than pay for the extra work involved.

Plums and peaches thinned do not suffer as much from the monilia or brown fruit rot, which in wet seasons nearly ruins the crop, as it generally attacks the fruit that are in clusters. The thinning out so that no two specimens touch acts as a preventive. The majority of up-to-date fruit raisers of the present time do in a half-hearted way thin the fruit on their peach and plum trees, but it is seldom we find a man in my neighborhood that has the courage to attempt to thin the apple. That is too great a task; he would rather go to the woods and cut a load of props to support the limbs. But the task is not so great if undertaken at the proper time. Most planters leave it too late, until the fruit is so large that the weight bends the limbs and they are in danger of breaking; then they remove part of the fruit. This is, of course, much better than to tie, or prop the limbs; but when fruit has attained this size, it is hard to remove without breaking or injuring the fruit spur.

The proper time to thin the apple is when it is the size of a hazlenut. This is just a few days after the second spraying. At this time they will snap off nicely at the outer end of the stem, and rapid work can be done. The tree will not be wasting its energy in nourishing an over-load of fruit, but that which remains received

the full supply and grows proportionately, and at the end of the season you will not only be entitled to the merited praise of "well done, good and faithful servant," but will also receive Nature's richest blessings in a bountiful harvest of choicest fruit.

RIPENING, PICKING, PACKING, REFRIGERATION AND MARKETING.

This is the period that is to bring to realization the dreams and bright anticipations in which the planter indulged, from the setting of the first tree, though the long years of painstaking care, when he planted in faith, nurtured in hope, watched it grow in strength and symmetrical beauty, and with the appearance of the first bloom, how eagerly he watched for the setting of the first fruit, with joy as great as the loving mother feels when her first born takes its first step, or the endearing word Mamma is lisped by sweet baby lips. And if his work has been a labor of love, it will be well done, and he will be richly rewarded for his labor and capital expended.

In describing the changes that take place during the period of evolution from the bud to flower, and the formation and ripening of the fruit, I cannot do better than quote Balfoure, one of the highest botanical authorities:

"While the fruit enlarges, the sap is drawn towards it, and a great exhaustion of the juices of the plant takes place. In annuals this exhaustion is such as to destroy the plants; but if they are prevented from bearing fruit, they may be made to live for two or more years. Perennials by acquiring increased vigor, are able better to bear the demand made upon them during fruiting. If large and highly flavored fruit is desired, it is of importance to allow an accumulation of sap to take place before they plant flowers. When a very young plant is permitted to blossom, it seldom brings fruit to perfection. When a plant produces fruit in very large quantities, gardeners are in the habit of thinning it early, in order that there may be an increased supply of sap for that which remains. In this way, peaches, nectarines, apricots, etc., are rendered larger and better flavored. When the fruiting is checked for one season, there is an accumulation of nutritive matter which has a beneficial effect upon the subsequent crop.

"The pericarp is at first of a green color, and performs the same functions as the other green parts of plants, decomposing carbonic acid under the agency of light and liberating oxygen. Saussure asserts that all fruits, in a green state, are adequate to perform this process of deoxidation. As the pericarp advances to maturity, it either becomes dry or succulent. In the former case it changes into a brown or white color, and has a quantity of ligneous matter deposited in its substance, so as to acquire great hardness, when it is incapable of performing any process of vegetable life; in the

latter it becomes fleshy in its texture, and assumes various bright tints in fleshy fruits, however, there is frequently a deposition of ligneous cells in the endocarp, forming the stone of the fruit; and even in the pulpy matter of the sarcocarp there are found isolated cells of a similar nature, as in some varieties of pears, where they cause a peculiar grittiness. The contents of the cells near the out side of succulent fruits are thickened by exhalation, and a process of exosmose goes on, by which the thinner contents of the inner cells pass outward, and thus cause swelling of the fruit. As the fruit advances to maturity, however, this exhalation diminishes, the water becoming free and entering into new combinations. In all pulpy fruits, which are not green, there are changes going on by which carpon is separated in combination with oxygen.

"Succulent fruits contain a large quantity of water along with cellulose or lignene, sugar, gummy matter or dextrine, albumen, coloring matter, various organic acids, as citric, malic, and tartaric, combined with lime and alkaline substances, beside a pulpy, gelatinous matter, which is converted by acids into pectine, whence pectic acid is formed by the action of albumen. Pectine is soluble in water, and exists in the pulp of fruits, as apples, gooseberries, currants, strawberries, etc. Pectic acid is said to consist of C. 14, H. 12 1 H. O. It absorbs water and is changed into a jelly like matter, hence its use in making preserves. Each kind of fruit is flavored with a peculiar aromatic substance. Starch is rarely present in the pericarp of the fruit, although it occurs commonly in the seeds.

"During the ripening much of the water disappears, while the cellulose or lignene and the dextrine are converted into sugar. Berard is of opinion that the changes in fruits are caused by the action of the oxygen of the air. Freney found that fruits covered with varnish did not ripen. As the process of ripening becomes perfected, the acids combine with alkalies, and thus the acidity of the fruit diminishes, while its sweetness increases. The formation of sugar is by some attributed to the action of organic acids on the vegetable constituents, gum, dextrine and starch; others think that the cellulose and lignine are similarly changed by the action of acids. The formation of sugar is said to be prevented by watering the tree with alkaline solutions. In seasons when there is little sun, but a great abundance of moisture, succulent fruits become watery and lose their flavor. The same thing frequently takes place in young trees with abundance of sap, and in cases where a large supply of water has been given artificially."

The fine large specimens of fruit raised by irrigation in California, that finds its way to our Eastern markets, are large and

beautiful in coloring, but lacking in flavor. We frequently have the same thing here in very wet seasons.

It is not easy in all cases to determine the exact time when fruit is ripe. In dry fruits, the period immediately before dehiscence, or bursting of the pods or hulls, is considered as that of maturity; but in pulpy fruits there is much uncertainty. It is usual to say that edible fruits are ripe when their ingredients are in such a state of combination as to give the most agreeable flavor. After such are ripe, in the ordinary sense, so as to be capable of being eaten for food, they undergo further changes by the oxidation of their tissues, even after being separated from the plant. In some cases these changes improve the quality of the fruit as in the case of the medler, the austerity of which is still farther diminished. In the pear this process renders it soft, but still fit for food, while in the apple it becomes a decay, which acts injuriously on its qualities. By this process of oxidation, the whole fruit is rendered ultimately a putrescent mass, which probably acts beneficially in promoting the germination of the seeds when the fruit drops to the ground.

The period of time required for ripening the fruit varies in different plants. Most fruits ripen within a year from the expansion of the flower, some come to maturity within a few days, others require months. Certain plants, as some coniferae, require more than a year, and in the metrosideros, a fruit growing in Australia, the fruit remains hanging for several years. The following is a general statement of the usual time required for the maturation of fruits:

Grasses and grains, 13 to 15 days.

Raspberry, strawberry and cherry, 2 months.

Bird cherry, 3 months.

Roses, white thorn, horse-chestnut, 4 months. Pear, apple, walnut, beech, plum, almond, peach, 3 to 6 months.

Olive, savin, 7 months.

The ripening of fruits may be accelerated by the application of heat, the placing of dark colored substances beneath, and by removing a ring of bark, so as to lead to an accumulation of sap. It has been observed that plants subjected to high temperature, not unfrequently prove abortive. This seems to result from over stimulation, causing the production of uni-sexual flowers alone.

WHEN RIPE.

We may learn to judge the ripeness of the larger fruits such as apples and pears by observation and experience. When ready to be picked they will have attained their full size, they will lose some of their greenness, and assume the more delicate tints we

observe in ripe fruit; but the best practical test is the ready separation of the stem from its attachment. In those fruits which are suspended by a stem of considerable length, and in which this organ belongs to the fruit itself, and is intimately connected with its tissues, we will find that it parts readily from the branch at that period of ripeness when it is best to separate it. When a pear is ripe, by taking hold of the fruit and springing it around one-fourth of a circle, it parts easily without breaking the stem. Some fruits attain their highest degree of excellence by leaving them hang to the tree until the texture of the fruit is soft. These varieties of fruits are best when consumed in the immediate neighborhood, for if picked in this condition, and are then to be conveyed to distant markets, they arrive in such bad condition as to render them unfit for consumption. Such fruits, as soon as separated from the branch, start in a process of decomposition, and soon decay. The peach is a fair illustration. Although peaches are now raised in remote sections hundreds of miles from the markets, they are picked as soon as they have attained size and the first indications of ripening. They are packed and at once placed in refrigerator cars and shipped by fast freight. They then arrive at their destination in very good condition. The latent heat in the fruit has slowly developed, and during transportation the fruit has attained a partially ripened condition; that is, it has attained color and softness, but unfortunately is unable to give flavor. Those living in our large cities, depending entirely upon distant shipments of what they consume, have not the remotest idea of the fresh crispness of vegetables when fresh plucked, or the juiciness, the sweetness, the rich flavor and delicate aroma of a tree ripened, Heaven kissed peach, having reached its full maturity beneath the influence of the cool nights, the dewy morn, and the genial warmth of the noonday sun.

This delicate fruit, when plucked a little too soon, will soften but never ripen. I do not think this fruit is really unwholesome, but it is certainly unpalatable. I do think there should be a law enacted that any person sending to market or exposing for sale any fruit that has ripened prematurely from diseased trees, should be held criminally responsible and heavily fined, for such fruit is unfit for human consumption. It contains germs that are injurious to health, and I believe that thousands of children in our large cities annually sicken and die of summer complaint and kindred diseases by being given this kind of fruit. The markets are full of it. Last Summer I went through the market house in a large city, which is supplied by farmers, and I saw stall after stall with baskets of unripe, wormy, knotty, half-developed, fungus covered and premature peaches, taken from trees in the last stages

of yellows—fruit the farmer would not eat himself, yet for the few paltry pennies this worthless trash brings, he stands a self-convicted criminal.

Some fruits, as apples, and many varieties of pears, are often much improved by a continuation of ripening after they are gathered. Some of the Summer varieties, it is true, will ripen while attached to the tree, but in most instances, if left too long on the tree, they become over-ripe, lose their juiciness, become mealy, and rotten at the core. The Clapp's Favorite, a fine juicy pear when plucked at the proper stage and ripened in a suitable place, will be utterly worthless if left hang until they get a yellow tint. Therefore, it is advisable with nearly every variety, to pluck them a little prematurely. In this condition they can be handled without bruising, which impairs their keeping qualities. The finer red Winter apples, we wish, of course, to have their brilliant color as fully developed as possible, and a few days in the Fall, with frosty nights and hot sunshiny days, adds considerably to the attractiveness of the apple, and detracts nothing from the keeping qualities. The flavor is also perceptibly improved, as we invariably find the well-colored specimens are also more highly flavored than those lacking color. Some varieties continue ripening for a long time on the tree, and for family use this is not objectionable in a summer apple, but for commercial purposes we want a variety to mature its fruit as nearly together as possible, otherwise the tree will need picking over two or three times; for such varieties, if all were to be picked when the first were ripe enough, we would find many entirely too green, and if picked would wilt before they would ripen. The expense is considered less when but once picking cleans the tree.

GATHERING.

This is one of the important matters—one that is looked forward to with pleasure as well as anxiety. There are different methods of gathering, as well as different classes of people to gather; some are careful, handling the fruit with as much care as though they were so many eggs; another class are careless, indifferent as to the condition of the fruit when barrelled. This man often starts picking all right, but soon tires of climbing up and down, repeatedly shifting the ladder, and the few fine apples at the top of high limbs, which he cannot reach, it is too much trouble to get the picker and take down one or two at a time, so to save time he shakes them down. They look all right, so he picks them up and puts them to the others. Now, he might just as well have shaken off the entire lot, for the few apples shaken are bruised where they struck the ground, and these apples are put indiscriminately with the sound apples in the barrels. The man who shakes his

apples is just as careless about other matters. The package is left standing exposed, gets wet, then is often stored in a close, ill-ventilated place, subject to change with every change of temperature outside. Those bruised begin to decay, the atmosphere in the close, warm, damp barrel is just right for the development of the rot germs, they multiply rapidly, other apples become affected when the fruit is shipped, and by the time it reaches its destination it is often in very bad shape indeed, and the commission man sends word back "received in bad order." Hands employed must be closely watched. I have frequently seen hands have their baskets hung on a limb and as they pick the fruit they throw it into the baskets. This is about on a par with the man who picks in bags. They take a long grain sack, put a small stone in one corner of the bottom, the upper and lower corners are then tied together; it is then slung over the shoulder, and a stick about one foot long, pointed at both ends, is put across the opening of the bag, with the pointed ends sticking into the sack. This holds the mouth of the bag open for the reception of the fruit. When the bag is full it is taken down and the fruit emptied out into a barrel or on a heap. This method is convenient, which is an incentive for so many people using it; but by the time the fruit is emptied there is scarce one unbruised fruit in the lot, for as the bag is being filled these apples are pressing each other with every motion of the body of the picker, as he reaches up or stoops down, or in reaching over a limb to get at the fruit in these places gives a new bearing to every apple in the bag, and by the time the bag is full the entire surface is full of slight, and often deep, indentations over the entire surface. These men wonder why their fruit does not keep, and in consulting with a wise neighbor are informed that they picked the fruit in the wrong sign. They depart sadder but not wiser men, but fully resolved that next year they will consult the almanac before picking. In strong contrast with the last method is the excellent method adopted by a great many successful fruit raisers, who, by the care they have given, have established a reputation and get high prices for their products, in both domestic and foreign markets. The most careful orchardists pick their fruit in baskets, holding from a peck to one-half bushel, mostly a round basket with a hinged handle to make it convenient to empty the fruit into barrels. The handle thus gives as the basket is slowly turned in the barrel. A hook is attached to the handle so they can be hung to the tree or ladder. The fruit is then carefully picked and laid one by one in the bottom of the basket. In picking, apples should be lifted up to separate the stem, instead of pulling down, which so often pulls the stem from out the cavity of the apple, which causes decay. They should always be laid in the

basket, never pitched in. It is often convenient to have a shoulder strap passing beneath the arm to which a basket may be hooked, leaving both hands free for work. Ladders of various sizes should be provided for reaching the various parts of the tree; step-ladders, five, six and eight feet, are the most convenient for picking from limbs not over twelve or fourteen feet high. Other ladders will, of course, be used for the upper branches.

The degree of maturity at which fruit should be gathered varies with circumstances. Maturity in apples and pears is generally indicated by the dark brown seeds, but as these cannot be examined, we must judge by external appearences. Winter apples should be mature, but not ripe. All late Winter apples should be gathered when too hard to yield to the pressure of the thumb, and always before heavy frosts. When apples that are naturally good long keepers begin to drop from the tree it is an indication of ripeness, and they should be gathered at once. Windfalls should never be picked up and mixed with the sound fruit picked from the tree, as they almost invariably have bruises and often have sun burns on the skin, which is injurious to the keeping qualities. In pears, there is a great difference in time of picking. The Bartlett pear may be picked when three-fourths grown, and still ripen with good flavor. Advantage is frequently taken of this circumstance to thin the fruit on the tree at this stage, thus easing the tree. These are then put in the ripening room until ripe enough for market; the balance left on the tree receiving more nourishment, make rapid growth, often attaining an immense size and bring extra prices, as fancy fruit, while those taken off early will in a week or two ripen into a fine melting texture and excellent flavor, and will bring good prices. Summer pears should be ripened in the dark. If placed in drawers and covered with a woolen cloth they will get a beautiful carmine or crimson cheek on a smooth golden surface, whereas if the same pear is left hang exposed to the sun, they will show perhaps only a light brown cheek. Nearly all pears are improved in color and have a much finer flavor if picked and ripened in the house. The exceptions are very few. Some, which are very poor when left to ripen on the tree, become rich, melting and delicious when house ripened. The usual season for gathering Winter fruits is in October, before severe frosts are expected, and at a time when the tree has completed its wood growth, and is ready for the separation of the leaves from their attachment. The fruit will at this time almost invariably part readily from the twigs, without breaking them, or the fruit stem, which should be neither broken or pulled from the fruit, if pulled out, decay frequently starts at this point. It has been proven by experience that pears and apples with broken stems never attain the fine color and flavor of fruit with perfect stem.

Some varieties will remain hanging to the tree until Winter sets in and the fruit is frozen. Other varieties, with just as good and often better keeping qualities, will drop badly in a few days after a severe frost. A knowledge of these peculiarities is valuable. Those subject to being affected by frost should be picked first, leaving the hardiest varieties until last. South of latitude 41 degrees the Baldwin, Rhode Island Greening, Hubbardston, Roxbury, Russet and Grime's Golden, should be picked early, as they are subject to drop especially after one or two hard frosts. Stayman's Winesap, York Imperial, Rome Beauty, Gano and Salome, can be left until the last as they adhere very tightly to the twigs and there is little fear of losing them by dropping.

For all fruits it is essential that the weather should be fine at the time of gathering. They should be perfectly dry and handled with care, and as soon as gathered taken at once to the place where they are to pass the Winter. The best place is a cool, well-ventilated cave or cellar. It should be so regulated that the atmosphere can be kept as uniform as possible; it is the continual changing of temperature that does more harm to the keeping of fruit than almost anything else. If considerable fruit is to be kept over, it is preferable to have a fruit cellar built for the special purpose, with ventilating flues so constructed that they can be open on cool days and nights and kept closed during the heat of the day, and in sultry, damp weather. If such a house is provided with bins, or better, a series of shelves, with slat bottoms, in this manner it is not necessary to put such large quantities upon each other when they can be better inspected and decayed specimens thrown out. This room should be kept cool and dark, and free from dampness.

An ideal place for keeping Winter apples is a convenient building over a large spring. If this is properly ventilated fruit can be placed in bins in the Fall and they will keep crisp and plump the entire Winter with very little loss, and retain their flavor to perfection.

Some large orchardists prefer placing their fruit at once in new barrels prepared especially for the purpose. Before placing the fruit, it should be carefully assorted, throwing out all wormy, knotty, or bruised fruit. If to be kept for a few months it is not necessary to face the fruit in the barrels, or to close them, as they will have to again be repacked before shipping. Many people have an idea that apples should go through a sweating process before storing. For this purpose they place them in heaps and cover with straw, or in covered bins, leaving them in the orchard until cold weather, when they are assorted and the good ones put into Winter quarters or sold. There will be considerable loss in bulk and

weight by the escape of fluids through the pores of the skin. Many varieties will become quite wilted. This is especially so if they are left uncovered as we frequently see them, or if left where a current of air passes over and through the pile. The russets, or any rough skinned apple, are very liable to wilt. What a great many take for sweating, is merely condensation of moisture from the atmosphere. The only advantage of this method is that more time is given after the fruit is gathered. The great disadvantage is loss by evaporation and the loss of that peculiar oily or waxy covering that covers our fruit and aids in their preservation, and should not be removed; hence the less the fruit is handled, the better, as it is apt to wipe off. If fruit in heaps or in bins becomes wet, it should be exposed to a dry atmosphere until this surplus moisture evaporates and the surface is dry, before being packed.

PACKING.

The method adopted at the Paragon Fruit Farm is, when the fruit is in condition, it is carefully picked into flat, peck baskets. When full these are carefully emptied into bushel crates by first covering the bottom of the box by hand, then the basket is held in the box an inch or two from the fruit, one hand placed in front of the fruit to prevent too hard falling, and the basket emptied slowly. When the boxes are filled as they should be, they are not quite level, so that two boxes of fruit can be set on top of each other. A spring wagon then comes along, the crates are gathered and loaded two tiers high, and hauled into the barn cellar, where they are unloaded and the crates piled one upon the other several tiers high. They are never left long in this condition, but as soon as possible (and the sooner the better) they are carefully assorted, discarding everything that is in any way faulty. They are then carefully packed in new barrels, placing a circular sheet of fine white paper cut to fit the barrel, on the bottom. On this the first layer is placed neatly in circles, with the stems down. The second layer is placed in the same way on top of the first layer. After this a half bushel is poured gently on top of the layers and the barrel is shaken gently to settle the fruit; another basket is emptied and settled, and this is continued until the barrel is filled about one inch above the chime. The top is leveled as evenly as possible, the head is then placed on top, the screw press is then adjusted, giving the barrel a few shakes as the head is being pressed into place. It is then secured with cleats, the barrel is reversed, and the stencil marks are put on. On this end we place the name, Paragon Fruit Farm, Boyertown, Pa.—the name of the fruit and the quality, whether Fancy XXX or XX. We endeavor to have the barrels run as uniform grade throughout as possible. For

facing we select apples as near uniform and of medium size, in preference to overgrown ones. As soon as we have a car-load ready we ship at once to the city to be put into cold storage, there to be held subject to our order. There is great advantage in having the fruit stored in close proximity to the market. In the Winter we often have a protracted spell of cold weather, rendering it unsafe to ship. The market becomes empty, prices advance, and when this occurs we telegraph to our commission man to sell such and such varieties. He takes our order to the storage company, gets the fruit and has it on the market in a few hours, without any risk of freezing. Our packages for apples and pears consist of standard size barrels, as adopted by New York State. We get the barrels made so that we have neat, clean, uniform packages. They cost more than old second-hand barrels, but we think the time saved in packing alone pays for the difference, and when exposed for sale the appearance is so much neater, more attractive, they bring so much better prices, that it is a good investment.

BOXES.

The question is before us, whether we shall use the box, or adhere to the barrel. The latter is the universal package for the apple throughout the Northern and Eastern states, and it will long continue so with the average farmer and fruit grower. But with the progressive horticulturist, the box is destined to soon supercede the barrel, for various reasons.

1st. It meets the wants of the average consumer. Not every family is prepared to buy, or have they the place to store a barrel of apples, and if the family is small many decay before they can be used. This prevents many people from buying; but if they could buy in small packages holding one peck, half a bushel, or one bushel, they would be regular consumers, and they would be willing to pay prices that would be very remunerative to the producer. It is likewise beneficial to the painstaking orchardist, as it enables him to put up his select fruit in neat, light packages, that it attracts the attention of the wealthiest class, who are willing to pay as much for a bushel box of carefully selected, even sized, attractive looking fruit, artistically packed, as they would for a full barrel of fruit as we see them on the market. These packages are light handling and convenient in every way. But the box will never become a favorite package with the careless farmer, or the dishonest one, as it gives him no opportunity of placing culls in the bottom or middle, as nearly every specimen is visible from the outside. That the box takes favorably in our markets is shown by the high prices paid for California and Hood River, Oregon, fruit. Such a reputation has this Oregon fruit gained, by careful selection

and packing, that it is invariably quoted at two to three times the price of our Eastern fruit. When the Eastern grower adapts himself, and grades and packs as conscientiously as our Western friends, his fruit will bring just as much, if not more, as it can be placed in the market with less handling, and in shorter time. Few people are capable of packing their own fruit; they cannot see the knots and worm holes.

The boxes should be new and made of the whitest wood available. Single boards for tops and bottoms are neater, but are harder to obtain. The proper thickness of box material is as follows: Ends, three-quarters of an inch; top and bottom, one-quarter; sides, three-eights. Thinner ends are apt to split, thinner sides to bulge, and thicker tops not to bulge enough, hence crushing the fruit when sprung into place.

SIZE.

There should be a national standard for size; as it is, every state has its own. The Pacific Coast uses a box with inside dimensions as follows: Ten and one-half by eleven and one-half by eighteen inches. This is their standard. This box contains 2,173.5 cubic inches, or slightly more than a struck bushel. They also use a "special," inside dimensions 10x11x20 inches, containing 2,200 cubic inches. The bulge on top and bottom adds about 150 cubic inches to the capacity of each.

Canada has a law governing the size of the apple box, which is 10x11x20 inches, the same size as the Western special.

To pack the fruit properly takes considerable practice. Packers must be trained to the business, and seldom become really expert until the second or third year. Not every one can become a first class packer, as it requires a naturally quick hand and a good eye for size. There are three styles of pack most commonly used. The "straight," "diagonal" and "offset." The straight or square pack is made up of rows running straight across the box and presents the neatest appearance, shown in Fig. 39, but is the hardest on the fruit as each apple is squarely opposed to its neighbor, instead of slipping into the recesses between them, as in the other styles. They may be put up in three ways, according to the size of the apples, and are called from the number of rows in a box, the three tier, four tier or five tier pack. The three tier pack (the largest size apples packed) should contain 45 apples to the box, with 5 apples to the tier; or 54, with 6 apples to the tier.

The four tier pack should contain 96 (six tiers long) 112 (seven tiers long) 128 (eight tiers long) or 144 (nine tiers long). The five tier pack should contain 200 (eight tiers long). One of the pretty points about the box package is that the exact number of apples

contained is always known, and if stamped on the box, adds to the value.

The diagonal pack is so called from the diagonal or oblique course taken by the rows. It is used for sizes intermediate, between those suitable for the straight packs. It should be used in preference to the straight pack whenever practicable, as it protects the apples from bruises. Only two kinds of diagonal packs are used, the three and one-half tier and four and one-half tier, so named from the number of apples required to reach across the box. The former

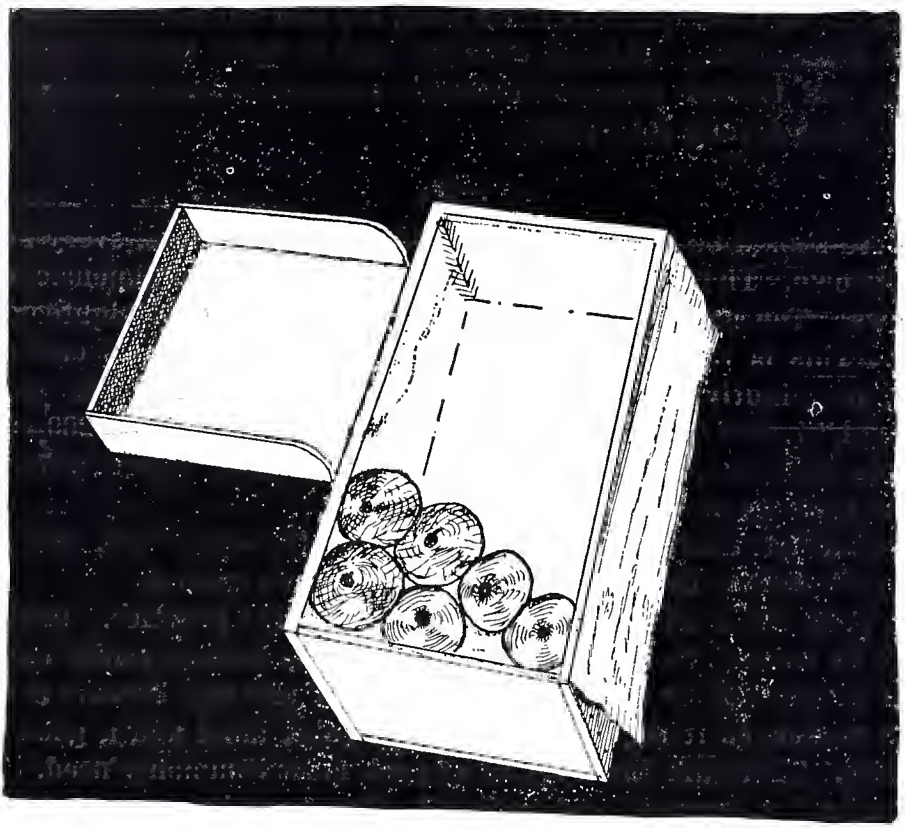


Fig. 37. Manner of starting the three and one-half tier pack, paper hod attached to side of box.

will go 64, 72 or 80 apples to the box, and the latter 150 or 175. The offset or orange pack is very similar to the diagonal.

Many growers having fancy fruit prefer wrapping each apple. It has the advantage of forming a cushion, retains the aroma of the fruit, acts as an absorbent, and if the grower prints his name and name of his orchard on each wrapper, it gives him an excellent advertisement, that comes direct to the consumer, creating a demand for his product, and attracting the best trade.

The first step in a perfect pack is to place a clean box upon the supports at the side of the packing table, which permit it to in-

cline conveniently toward the packer. (Fig 37.) The lining paper is put in. Lining papers are of cheap, soft white paper, in width slightly less than the length of the box, and about 26 inches long. One sheet is required for each side, the two overlapping on the bottom of the box, enough being left outside to fold over the top as in Fig. 37. To prevent tearing along the bottom corners when the bottom bulges, a pleat is folded into each sheet about six inches from the end. This is done by catching the paper at the edges so as to turn a fold into it, and crease it by drawing it swiftly over the knee. The pleats lie along the corners and provide plenty of slack. Next a layer of thin, soft cardboard just the size of the box, is laid in the bottom. You are now ready for the first layer of apples. If the apples are to be wrapped, it is convenient to construct a hod to hold the wrappers by having right angle hooks attached to the hod so that it can be hooked over the edge of the box. This brings the paper within easy reach of the packer. To aid in picking up the paper, the packer wears a rubber finger stall on the first finger or thumb. The wrapping-paper for ordinary apples is cut in squares 10x10 inches. Very large fruit requires 12x12 inches. The fruit is picked up in one hand, the paper in the other, they are slapped together, and by a dexterous twist the loose edges are gathered into a bunch over the stem. When accustomed to the work it takes little longer to wrap and pack than it does to place the fruit in the box unwrapped. The wrappers are especially advantageous in the diagonal and offset pack, making a springy cushion for each apple. The manner of putting up a straight pack is too plain to need a description; merely have them nicely graded and place them in straight rows.

The way to start a diagonal pack is shown in Fig. 37. It becomes still simpler to pack the box from the side, for then it resolves itself into the offset pack of each row alternating with its neighbors; but it is more convenient to work at the end of the box in all styles of packs. The box —— in Fig. 37 shows how to begin a layer in a three and one-half tier pack The two apples in left-hand corner are first placed diagonally across it, then one snugly in the right-hand corner, and a fourth above and at the left of this wedges it securely into place. Then follow two more apples, as in Fig. 37. Continue until layer is finished. In the middle layer two apples are placed across the right instead of the left-hand corner, while the bottom layer is identical with the top as shown; hence each apple in each layer comes opposite a space in the adjacent layer. When the box is finished it should resemble that shown in Fig. 38. The four and one-half tier is started by placing one apple in each lower corner and one in the middle; two are then pushed down as far as they will go on either side of the middle

apple and followed by three more apples corresponding in position to the first three, and so on until the layer is finished. Getting the bulge is an important feature, though difficult for the beginner to get the end rows to come flush with the ends of the box, or slightly above them, and yet have the centre about an inch and a half higher. To get this it sometimes becomes necessary to stand part of the apples in the middle row the opposite way from the others to increase the heighth, but the skillful packer can, by selecting the larger fruit, raise the middle sufficient. A crown of one and one-half inches gives about the right bulge at top and bottom, when the cover is nailed on, of three-quarters of an inch. If more, the pressure is too severe; if much less, there is

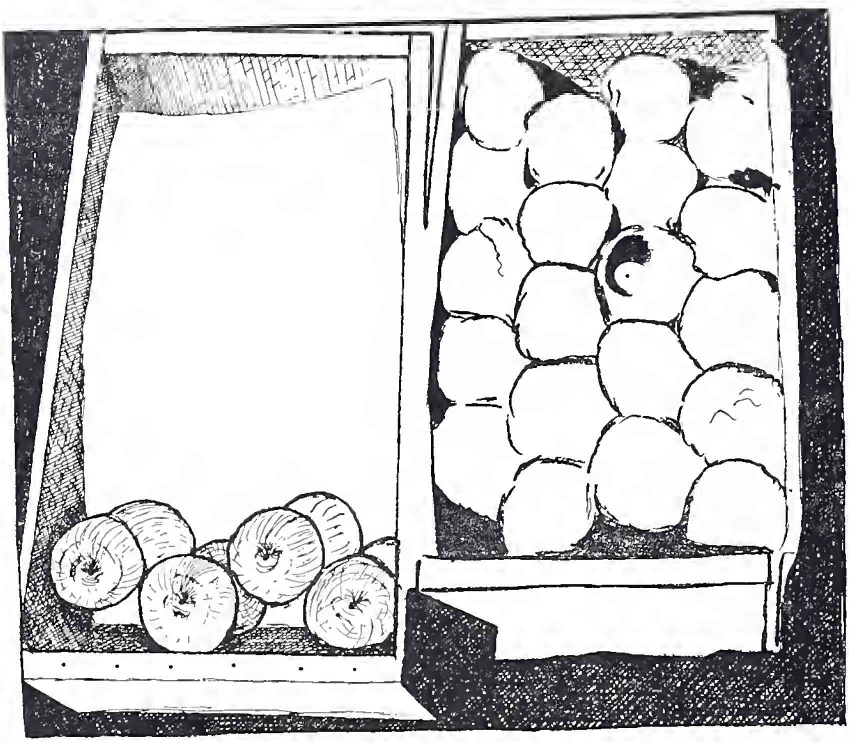


Fig. 38. Manner of starting the three and one-half tier box, on the left. The same wrapped and packed on the right.

danger of becoming slack. In a properly packed box each layer should be so snugly fitted that they cannot be shaken even after light shrinkage. The figures here given are from photos of fruit packed at the Paragon orchards; although the majority of the fruit is packed in barrels, I expect in the near future to use the box for my finest fruit.

Whether you use the barrel or the box in packing for market, always endeavor to put up your goods the best you know how. Don't get the notion that an old barrel or box is good enough. I know men who use old fish, oyster and cement barrels, because they get them

for a dime apiece. Then don't get the idea that you are a little smarter than the city fellow, that you can put a layer or two of fine apples on one end and fill the middle with culls; that he will not know where they come from. Do you know that the man who uses cheap barrels, and packs them dishonestly gets his desert; he is the man who is always complaining that he was cheated; that fruit raising does not pay.

If your goods are put up square you need not be ashamed to put your name and the name of your farm on every package. Sell them under a guarantee; customers know when they are treated square, and they will come again. They get acquainted with your stencil number, or your trade-mark, and ask their dealer for it.

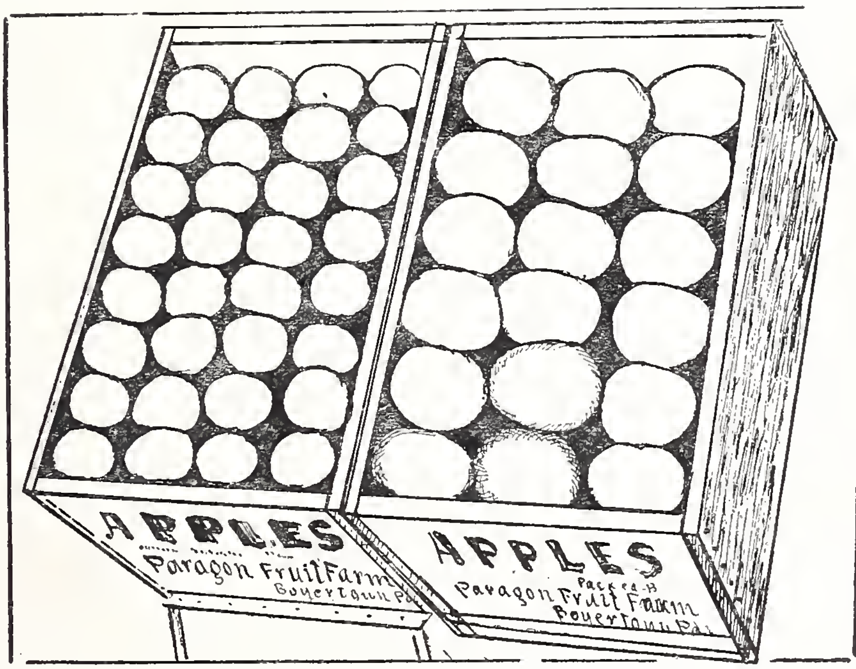


Fig. 39. Shows three tier pack on the right. Four tier on the left, unwrapped.

REFRIGERATION.

A word in regard to refrigeration. Does it pay to place your fruit in refrigeration, and pay thirty-five or forty cents per barrel. It depends on the method of refrigeration and the condition of the fruit when it is placed in storage. As we find a great many mixed cold storage houses that are cooled by ice overhead, it will not pay you. They tell you their rooms register 35 Fahrenheit. Don't believe it; it is an utter impossibility to get it that cold by melting without salt applied. A good, well constructed refrigerator, if it is kept well closed (not leaving every one run in and out at pleasure) will register about 37. Now this temperature, if held regular, will

hold certain varieties of good keeping winter apples fairly well until Spring, but that same class of apple will also keep in a good cave or cellar. But it is not cold enough to keep the average apple; the latent heat in the apple will develop and ripen slowly, but never theless sure. To keep, apples must be held at a temperature of not over 33 and 31 would be better. Water and potatoes freeze at 32 F., but you need not fear for your apples; it requires 28 degrees F. to freeze an apple.

The many plans for the construction of small storage plants that are given in different bulletins and agricultural reports render it unnecessary to give any plans in this work. Suffice it to say, that the great majority of small houses cooled by ice on the side or overhead are comparative failures. The time refrigeration is most needed is in the fall and early winter; therefore, the storage capacity for ice must be large enough to carry over a large body, which is difficult. In the year 1881, I constructed a cold storage plant, with an ice chamber holding one hundred tons of ice, the air in the front room coming in direct contact with the ice. As long as the ice lasted, this gave a temperature of about 38 degrees F., but by the time ice was most needed it was gone. Thinking I could hold it longer and still cool the room sufficiently, I put a galvanized floor under the ice. This had the desired effect as far as the ice was concerned, but the temperature raised to 40 F. This was not cold enough to hold fruit. Several years later I built another on the latest scientific principles, with solid walls 18 inches thick, plastered inside; then 12 inches dead air space, then a 4 inch space filled with ground charcoal. The ice chamber held over 600 tons of ice. The air of the refrigerator room had free access to the ice. The temperature in this house was very even, at 37 degrees, and keeps apples of late keeping qualities very well, but fall varieties and pears cannot be kept as satisfactory as desired, as too much of the fruit decays by February and March. This house was constructed at an expense of over $4,000.00. After years of experience with cold storage I am satisfied that the only satisfactory method of cold storage is by means of mechanical refrigeration. By this means the temperature can be held at any degree wanted.

The best temperature for apples is thirty-one to thirty-two degrees. This temperature retards the ripening of the fruit. It also checks to a greater extent the development of diseases and scald. When the fruit is removed from cold storage to a warmer temperature, it remains in good condition longer than when taken from a higher storage temperature. In the latter case the ripening has progressed more rapidly in the warehouse, and the fruit is nearer the end of its life. A great deal depends upon the time the apples are picked. They should be fully grown, well colored, but still hard.

Many think that an apple picked premature will keep better, but experience teaches differently. Immature fruit deteriorates more quickly than apples that have reached a higher degree of maturity on the tree. The immature fruit is apt to lose in firmness, and is more susceptible to scald. When apples are handled in large commercial orchards, it is not always possible to get them picked at just the exact time they should be, as labor is often scarce, and the owner is often compelled to begin before the fruit is in the best condition. Then he must utilize all the time, and is often compelled to pick during unfavorable weather, and with all his push some of the fruit will get a little riper than he likes. Then apples on the same tree often differ widely in the degree of maturity attained at a given time. The fruit on the upper exposed branches ripens in advance of those on the lower limbs and those shaded in the interior of the tree. It is impossible to get uniformity in maturity when the entire product of the tree is picked at one time. If time would permit, greater uniformity would be attained by picking over the tree two or three times, taking the apples at each picking that have attained the desired size and color.

The behavior of apples in storage depends somewhat on their condition when they enter the room. No two lots will act just alike unless they are in a similar condition when stored. If one lot ripens more than the other during the time between picking and storing it will deteriorate much sooner in the storage house. If the diseases in one lot have progressed farther than in another, the premature death of the fruit may be looked for earlier. A fruit is a living body; its life processes go forward rapidly at high temperatures, and it soon reaches the end of its life. In low temperatures the life processes are retarded, though they progress slowly in the lowest temperature in which the fruit may be safely stored. In a similar respect the diseases which affect the fruits are due to living organisms. They multiply rapidly in high temperatures and are retarded by low temperatures. Some diseases, like the bitter rot and apple scab, are checked by a temperature of 31 degrees to 32 degrees Fahrenheit, while others, such as the black and blue moulds, grow slowly in the lowest temperature at which fruit may be stored without freezing.

If the fruit has been grown under conditions that cause it to pass through its life history more quickly than the same variety grown under different conditions, it may be expected to reach the end of its life at an earlier period. The cold storage does not obliterate the difference that exists in the various lots of fruit when they enter the storage house; it rather retards, while not preventing, their normal development.

APPLE SCALD.

Apple Scald often causes serious loss in many varieties of apples placed in cold storage. This difficulty generally develops toward the end of the storage season when the fruit approaches the end of its life, or it may appear early in lots of apples that after picking have been left to partially ripen before they have been placed in storage. The scald appears as a brownish discoloration of the uncolored portion of the fruit, that is, on the portions developed in the shade. An apple picked prematurely is more subject to scald than one that has developed to the highest degree of color before picking. In fact, highly colored apples of a variety that is subject to scald, seldom develop the trouble. Some varieties are much more susceptible. Grime's Golden, Wagner, Langford, poorly colored York Imperials, Baldwins, and other sorts, are often badly scalded. The nature of the scald is not well understood. It is not the result of bacteria or fungi, which grow in the fruit, as is the case with the common fruit rots. It appears to be due to the normal oxidizing ferments of the fruits, which cause the premature death of the cells of the apple just beneath the skin. These cells die and finally turn brown, producing the characteristic discoloration of the skin. The trouble does not extend deeply into the flesh of the apple. Some pears, when placed in cold storage for a time become so badly discolored by scald as to render them unsalable.

PREVENTION OF SCALD.

Cultural conditions and proper handling are the only known means of avoiding this trouble. It is necessary to grow highly colored fruit in order to reduce the susceptibility to the trouble. This can be done by pruning, keeping the trees open headed, that the fruit may at some time during the day have the benefit of the sun. The trees should not have too much stimulating nitrogenous food, but more of the mineral elements. Potash, iron, lime, etc., are great aids to high coloring, while trees making too rampant growth, too thick in branches and foliage grow large fruit with little coloring. Then do not delay the storage one day, if possible, as during picking time the temperature averages about 60 degrees Fahrenheit, and at this temperature fruit matures and the diseases grow with unusual rapidity. Keeping the fruit in piles or packages in the orchard for several days in dampness and heat, is very favorable for the different disease germs to develop, and such fruit may have already commenced deteriorating when they went into storage. The beneficial effects of cold storage are of great importance to the commercial orchardist, permitting him to hold many varieties of perishable fruits until the markets are ready to receive them, and pay remunerative prices for them. But one thing must be borne

in mind, cold storage never improves the quality of any kind of fruit, but it is always stored at the expense of flavor. The apple retains flavor longer than most fruits. The peach loses flavor in twenty-four hours exposure to refrigeration, and if kept one week they come out with but the semblance of the peach, having lost all their high flavor. The strawberry becomes almost tasteless in one week's refrigeration. The fine fruit raised in the Southern states that needs refrigeration to get it to our Northern markets, has none of the fine qualities of the same varieties raised here.

Before closing this important topic, it might be well to refer to the "New Process for Keeping Fruit Fresh," which was published in 1895 by the Department of State (Bureau of Statistics, by Henry P. DuBellet, Consul at Rheims, France), and distributed by the Division of Pomology of the Department of Agriculture.

"Impressed with the powerful action of alcoholic vapors on the mould which generally appears on the surface of fruits in a damp atmosphere, Mr. Petit noticed that pears and apples kept for several months in a surrounding saturated with vapors of water and alcohol, even were they in the beginning in a state of decay, showed no signs of mold, while fruits in every particular identically similar to the former, stored under the same conditions, but not exposed to the action of alcoholic vapors, were entirely covered with it. Taking advantage of this observation, Mr. Petit applied the principle to the preservation of fruits in general, and most particularly to grapes, because, more than others, the latter are subject to mold. It was to be foreseen that grapes kept from the day they were cut off the vines, in an atmosphere saturated with vapors of water and alcohol; by retarding of the sweating period, not only remain free from mold, but would even retain their natural aspect. Consequently, should the temperature be constant and low, the preservation could be maintained long and well.

"On October 31, 1894—that is very late in the season and at a very unfavorable time—Mr. Petit placed with other fruits and a bottle filled with 100 centimeters (61 cubic inches) of alcohol at 96, some bunches of grapes known as 'chasselas de Fontainebleau' fresh from the vine, in a brick recipient in the form of a parallelopiped, cemented inside and closed as hermetically as possible by a common wooden door. In two similar recipients, contiguous to the first, one of which was kept open and the other closed, but without alcohol, were stored similar fruits from the trees and vines. The fruits were laid on wood shavings. The recipients were built in a very damp cellar, the temperature of which varied regularly from 10 to 8 C. (50 to 46 2-5 F.) during the whole time the experiment lasted.

"On November 20, the grapes placed in the recipient left open, and especially those in the closed recipient without alcohol, were mostly rotten and covered with mold, and were immediately removed. In the recipient containing the bottle of alcohol, the grapes were beautiful. On one bunch two grapes had turned brown, but were firm, full, and free from mold. They did not taste at all sour, thus differing essentially from moldy grapes. On December 7th the bunches of grapes in the recipient containing the alcohol had kept their fine aspect; on most of them, however, one or two grapes had turned brown, and were in the same condition as those above referred to. On Dècember 24, same results; on most of the bunches could be seen one or two grapes commencing to decay. At the end of nearly two months, each bunch had lost but from two to four grapes each and all were in perfect state of preservation, the stalks were perfectly green and the grapes firm, full, and savory, and having all the qualities of fresh grapes.

"This process offers many advantages. It is simple, easy of application, and cheap, and, if adopted by our fruit growers, would allow them not only to hold their fine fruits until they can dispose of them at a fair price, but would also insure them handsome profits during the Winter months."

This process would be worthy of trial, and if successful would certainly be cheaper than refrigeration.

MARKETING.

The successful distribution and selling of fruit lies in searching out the best markets, and then in finding out what the consumer wants. This can be done only by giving as much attention to the market end of the business as to the horticultural end. The grower who expects to handle his own fruit directly should visit the markets, and should take particular pains to determine the special brands and types of fruits which the consumer in that market requires. It is generally true that the fruit grower raises whatever comes handy, and sells it if he can. It would be better business to determine what the market is likely to demand, and then to grow the article that is wanted. The essence of modern trade is the specialization of business and the individualizing of the consumer. The person who has much fruit to dispose of, especially if of a perishable nature, should begin to seek his markets several weeks in advance, so that when the fruit is ready he will know where to dispose of it to the best advantage. Much of the success in marketing depends upon the quality and the quantity. If the quality is all right, it is half the sale. But dealers who handle large quantities of fruit ordinarily demand that the grower furnish them with stated quantities of stated varieties; and if the grower

cannot do this he may be unable to hold his customer. The grower and dealer should work in unison. The shipper should notify the dealer of the amount and quality of fruit he will ship at a given time. This gives the dealer the opportunity of notifying his customers and thus find an outlet for his goods regardless of the condition of the market. When a reputation is established by honest packing and fancy goods, the consumer seeks the goods. Where certain fruits are grown in car-load lots and the quality is such that a reputation is established, buyers come and purchase the fruit F. O. B. at your station. This is the best way to do business, as you are always working on a sound cash basis.

THE APPLE.

Pyrus Malus, as it grew in its wild form was of small size, of very poor quality, growing upon thorny irregular trees. We still see seedling trees that have sprung up in the fence rows that have gone back to their wild natural condition. It was by favorable conditions, and by cross pollenization and cultivation, that this small indigestible fruit, has been improved until we have the large vigorous upright tree free from thorns, and producing large, delicious and easily digested fruit.

This king of fruit is supposed to have its origin in Europe. As far back as the Christian era mention is made of as many as nineteen varieties. It is doubtful if one of those early varieties exist at our present day. They have disappeared and are superseded by newer sorts of higher merits. Evolution is constantly taking place. It is within comparatively few years that many valuable varieties possessing beauty, quality and hardiness have by cross breeding produced from the common crab-apple (Pyrus baccata). The Wealthy, Peter and Gideon and others belong to this class, their extreme hardiness being their strong recommendation. They can withstand the severe winters of the northwest where many of our fine varieties winter-kill. In this country many of our choicest varieties have originated by chance, by the accidental crosses of good varieties, or by the intervention of insects, the honey bee being one of the great factors in cross pollenization. To this industrious little friend do we owe a debt of gratitude for its instrumentality in giving us many of our choicest and most delicious fruits, as well as the thousands of beautiful flowers with their bright tints and sweet perfume. The apple, though introduced into America from Europe, has gone through so many changes that the majority of our cultivated varieties to-day are of home origin, showing that our seedlings, grown and acclimated in America, are much better suited to our conditions than are those introduced from other countries.

The climate and soil of the Northern United States are peculiarly well adopted to the growth of the apple. and no country in the world can produce apples of so fine quality, so brilliantly colored, or that will keep so long. Our fruits have within the last decade gained a world-wide reputation, and the end is not yet. New varieties of greater excellence are being brought forth annually, and such noted men as Luther Burbank of Santa Rosa, California, and others, are doing a great work, along the line of cross pollenation. As far back as 1597 mention is made of seven different kinds of Pippins, in the history of plants issued by John Lerard. The following is given as a sample of the pomology of that day: "The fruit of apples do differ in greatnese, forme, colour and taste, some covered with red skin, others yellow or green, varying infinitely according to soil and climate; some are sweet of taste, some are sour, most be of middle taste between sweet and sour; the which to distinguish, I think it impossible, notwithstanding I heare of one who intendeth to write a peculiar volume of apples and the use of them." He further says: "The tame and grafted apple trees are planted and set in gardens and orchards made for that purpose; they delight to grow in fertile grounds. ent doth abounde with apples of many sortes; but I have seen pastures and hedge-rows about the grounds of a worshipful gentlemen dwelling two miles from Hereford, so many trees of all sortes, that the servants drinke for the most parte no other drinke but that which is made from apples."

Dr. Lerard fully appreciated the value of fruits, and thus vehemently urges his countrymen to plant orchards: "Gentlemen that have land and living, put forward, graft, set, plant, and nourish up trees in every corner of your grounds; the labor is small, the cost is nothing, the commoditie is great, yourselves shall have plentie, the poor shall have somewhat in time of want to relieve their necessitie and God shall reward your good minde and dilligence."

Virgil, when speaking of the importance of grafting to increase the number of trees of any variety advises to

> "Graft the tender shoot,
> Thy children's children shall enjoy the fruit."

So high an estimate did Pliny have of the apple that he asserted: "There are apples that have enobled the countries from whence they came, and many apples have immortalized their first founders and inventors, our best apples will immortalize their first grafters forever."

The celebrated Golden Pippin was originated at Perham Park in Sussex, England, and this variety has attained a high reputation in that country, though it has never been considered so fine in this country, where we have many varieties of better quality. In 1685,

Evelin says at Lorn Clarendon's seat at Swallow Field, Berks, there is an apple orchard of 1,000 golden and other cider Pippins. The Ribston Pippin, which every Englishman will tell you is the best apple in the world, is a native of Ribston Park, Yorkshire. This apple is well known in this country, the older orchards still having trees of that variety, but it is now little planted, as it is not a favorite here where we have so many more worthy sorts.

Alas for human vanity and apple glory! Where are now these boasted sorts, upon whose merits the immortality of their inventors and first grafters were to depend? They have disappeared from our lists to give place to new favorites which will for a few fleeting years hold the place of honor, the standard of excellence, until maturer methods, or higher skill and more scientific applications of knowledge shall have produced superior fruit to any of those we now prize so highly; and this is a consummation to which we may look forward with pleasure. The large proportion of our best varieties of apples, have originated by accident, that is, they are the production of nature unaided by the skill of man. They have been discovered in seedlings that have sprung up in out of the way places, and produced fruit of sufficient merit to attract attention, and often gain a local reputation for years before they are introduced to the public at large. These accidental crosses are happening continually. Linnauas was the first to discover and call attention to the sexual characters of plants, which created a revolution in botany. Lord Bacon's attention being attracted to the matter predicted that there might be such a thing as crossing the breeds of plants, when he says:

"The compounding or mixture of plants is not found out, which, nevertheless, if it be possible, is more at command than that of living creatures; wherefore it were one of the most notable experiments touching plants to find it out, for so you may have great variety of new fruits and flowers yet unknown. Grafting does it not, that mendeth the fruit or doubleth the flowers, etc., but hath not the power to make a new kind, for the scion ever over ruleth the stock." The gardeners of Holland and the Netherlands were the first to put into the practice the cross fertilization of fruit.

POLLENATION.

The following extract is given to explain the manner in which Mr. Knight, the pioneer in this branch of Pomology, conducted his experiments, which rewarded him with some varieties of fruits which were very highly esteemed. "Many varieties of apples were collected which had been proved to afford, in mixture with each other, the finest cider. A tree of each was then obtained by grafting upon a Paradise stock, and these trees were trained to a south

wall, or if grafted on Siberian crab, to the west wall, till they afforded blossoms, and the soil in which they were planted was made of the most rich and favorable kind. Each blossom of these species of fruit contains about twenty chives or males (stamens) and generally five pointals or females (pistils) which spring from the center of the cup or cavity of the blossom. The males stand in a circle just within the basis of the petals, and are formed of slender threads, each of which terminates in an anther. It is necessary in these experiments that both the fruit and seed should attain as large size and as much perfection as possible, and therefore a few blossoms only were suffered to remain on each tree. As soon as the blossoms were nearly full grown every male in each was carefully extracted proper care being taken not to injure the pointals and the blossoms thus prepared were closed again, and suffered to remain till they opened spontaneously. The blossoms of the tree which it was proposed to make the male parent of the future variety were accelerated by being brought into contact with the wall, or retarded by being detached from it, so they were made to unfold at the required period; and a portion of their pollen, when ready to fall from the mature anthers, was during three or four successive mornings deposited upon the pointals of the blossoms, which consequently afforded seeds. It is necessary in this experiment that one variety of apple only should bear unmutilated blossoms, for when other varieties are in flow at the same time, the pollen of these will often be conveyed by bees to the prepared blossoms, and the result of the experiment will be in consequence uncertain and unsatisfactory."

It is of course necessary to have the two varieties bloom at the same time, either naturally or by retarding one of them. It should also be understood that there is a distinction between a hybrid and cross, simply crossing varieties of the same species, such as apple with apples, or pears with pears is not difficult, and in so doing we do not have any male progeny, this process is being carried out in nature every season, and many most excellent varieties are now being produced by the aid of man. We may have two excellent varieties of fruit but one may be weak in one point, in which the other is strong, now by crossing these two varieties we may be enabled to implant this one strong point into the other variety, without in any way impairing the good qualities it already possesses and thus by combining the virtues of the two we produce a fruit of greater excellence. Hybrids are produced when the pollen of one species is used to fertilize the ovules of another closely allied species of the same genius. But many of these it seems cannot be hybridized as we have no instance in which the pear has crossed with the apple. In a hybrid there is a mixture of the elements of

each parent, and the character of the cross will depend upon one or the other, which it will resemble. There is little doubt that the nectarine is a hybrid between the peach and the plum, it partakes of the nature of both. The tree resembles the peach so closely as to be scarcely distinguishable, also the stone, while the outward appearance of the fruit with its smooth skin belongs to the plum family.

RUNNING OUT OF VARIETIES.

Do our varieties in the course of time run out, losing the virtues that give them their wide reputation? In many instances it would seem that they do. Opinions differ greatly on this point. A great many high authorities claim that any variety of fruit can have but a limited period of existence, which may be longer or shorter, depending somewhat upon inherent vigor or stamina of the variety.

Harvey claims that the true life or history of a tree is in its buds, which are annual, while the tree itself is the connecting link between them and the ground. Any portion of such a compound existence, grafted upon another stock, or planted immediately into the ground itself and established upon its own roots, will produce a new tree like the first, being furnished with supplies of nourishment it may grow indefinitely while retaining all the qualities of the parent stock; if that be healthy and vigorous so will be this, indeed new life and vigor often seem to be imparted by a congenial thrifty stock, and a fertile soil, so that there does not appear to be any reason why the variety should ever run out or disappear.

Theoretically this view would seem correct, but we know that many varieties or different fruits do run out and disappear or become unprofitable as it were by exhaustion, and whether from age or over-production become constitutionally weakened and fail to produce the same grade of fruit. Even if, as Harvey states, that the buds are the life of the tree, may these buds not also become so devitalized that when they are severed from the parent tree and grafted upon another tree, that so much of this inherent weakness may be transmitted with the buds to the new stock as to more or less affect it and degeneration continued.

We have many instances of apples that fifty years ago were very productive and of the highest quality, that are now unworthy of a place in the commercial orchard. The Winter Rambo was an apple, as formerly productive, of the highest quality, the trees were thrifty growers, and very productive; this same variety now, planted in the same location, with all the environments the same, no longer yield profitable crops, and the fruit lacks its former high quality. The Catharine pear is another instance, throughout Eastern Pennsylvania, great large healthy trees stood on nearly every farm, producing immense crops of fine perfect fruit of high quality, but they

seem to have run their course, and are on the decline. The fruit is deteriorating year by year, falling below the standard in size and quality, core rotting before they are ripe. The Isabella grape was once the leading grape, being remarkably prolific whereever planted, bunches large, berries plump and of excellent quality. Now how many can raise this once valuable grape, the vines grow with all the vigor of former years, but the fruit will not ripen here and there a few scattered berries will ripen on the bunch, but by the time frosts and freezing weather comes the vines will be hanging full of grapes in all stages, from perfectly green half-developed grapes to those fully matured. These are not isolated cases, but so general that the variety is no longer planted. Thus we find in many kinds of fruits, what was once profitable, it is now useless to plant, but as long as new varieties of greater excellence are being constantly produced through natural means, or through the instrumentality of man we are not the losers but every new addition is our gain.

APPLE GROWING IN PENNSYLVANIA.

Pennsylvania stands second in production, and on a par in quality with any state in the Union; and I am pleased to say that apple growing in this State is receiving more attention year by year by thoughtful horticulturists, who by care and energy are producing fair crops of apples annually, and all honor is due the men who are persistently laboring to bring apple growing to a higher standard and make it a permanent industry. The adaptability of the climate, soils, etc., are beyond dispute, the railroad facilities for transporting our products to Philadelphia and New York for home consumption and export, the many excellent local markets, situated in nearly every county in the State, render the growing of good fruit a safe and profitable investment.

The principal feature of propagation of trees from the nursery, the method and distance of planting, their culture and care in the orchards, their diseases and insect enemies, including the best and most effective methods, of combating and eradicating these, soils best adapted, sites most desirable, the best methods of gathering, packing, storing and marketing, are all treated elsewhere within these pages. The one important topic of varieties most profitable, both domestically and commercially, and their adaption to the locality, will now be given the consideration it deserves. Hash becomes nauseating by too frequent use. This applies as forcefully to mind as to matter. I do not desire to bore the reader by much repetition, but I do wish to impress upon your mind the importance of a judicious selection of varieties, suitable to your immediate locality. A variety may have all the desirable traits to recommend it

in New York and Ohio, yet unprofitable to you, so that the more you would have the poorer you would be. One thing bear in mind, that all varieties originating north of you, the life of the fruit will be shortened, it will mature earlier by moving it farther south and lengthen by taking it farther north. If the grower lives north of latitude 41, or even a little below this line, providing he has an altitude of 500 to 1,000 feet, he may plant the Baldwin, Greening, Northern Spy, etc., with fair hope of success. But any one living south of this line unless the difference in latitude and longitude is made up in altitude, go slow on these and other varieties that are favorites in the Northern and Northwestern states. Through correspondence and conversation with fruit men in evey county in the State I find this rule is holding good. In every instance those who live near, or south of Latitude 41, unless their sites lie high, these varieties drop early and lose their keeping qualities.

How Shall We Make Our Selection.—There are a few general rules or precepts which will aid the intending fruit planter in the choice of varieties. So far as possible follow your own personal preferences —the type of fruit you love best, or take the most interest in. These are the ones with which you will be most likely to succeed. Obtain a clear and specific idea of the purpose for which the fruit is to be grown—whether for dessert, canning, evaporating, for local market or export. Then select the varieties which are best suited to meet these ideals. Do not covet a variety simply because it does well in another region. Varieties have distinct adaption to geographical areas. The varieties that are universally successful in Northern New York are a total failure in Southern Pennsylvania. Diversification must come to be more important in fruit growing; and any region should grow that type of fruit most freely that grows to perfection in that locality, and does not do so well in others. Choose with reference to local environments; always consider the adaption of the variety to your particular conditions, as to the length of the season, your methods of cultivation, the distance from market, the tastes of the customers. Do not attempt to grow the finer quality of dessert fruits commercially, unless you are prepared to cater to its wants, as we find they require more care and better cultural treatment than the ordinary apples, that is the reason they are generally unprofitable.

Choose also with reference to inter-pollenation. Some varieties of fruit are self sterile—that is when planted alone they are not fruitful. This is more generally observed with the strawberries, and the pistilate, or infertile variety, is never planted alone. This same condition prevails to a less extent in many of our larger fruits. Some are strongly staminate, others less potent. This impotency or self sterility is largely a varietal characteristic, yet it is no doubt

greatly modified by seasonal environmental conditions. It is probable some varieties may sometimes be self-fertile and at other times self-sterile. It were better if more attention and study were given to this matter as it is but little understood. We know that the most productive orchards are usually those having many varieties planted together. Some of the most marked cases of impotency are found in the plums of the wild goose type. One point that should be observed in planting is that the varieties in close proximity shall bloom at the same time.

Self-sterile Varieties of Apples, More or Less.—Gravenstein, King of Tompkins County, Northern Spy, Primate, Rambo, Roxbury, Russet, Spitzenburg, Tolman's Sweet, Winesaps. Even the Baldwin, which is classed as self-fertile, is known to be unprolific when planted in very large solid blocks and it is an open question if any variety is as productive or produces as fine fruit when self-fertilized.

Varieties Considered Strongly Self-fertile.—Ben Davis, Baldwin, Fallawater, Greening, Duchess of Oldenburg, Red Astrachan, Smith's Cider, Stayman, York Imperial, Rome Beauty, the latter blooming late is a good partner with Northern Spy. The best method for the novice with no experience as to varieties, their merits and demerits, would be in selecting, to visit among the orchards in his vicinity, taking note of those that are productive and have good marketable qualities, and if annual bearers, so much the better. You will gain more actual knowledge by this means in a day or two, with little expense than you would by reading pages of nurserymen's catalogues, where everything is good they have for sale. It is a curious fact that the weak points are never spoken of, and it is an utter impossibility for the planter to make a proper selection of varieties for any location from descriptions alone, as given in the catalogue. In selection of varieties the grower will of course be governed to some extent on the purpose for which he is planting. If for home use only, he will plant such varieties as suit individual taste, or for beauty, regardless as to productiveness, and he will plant a greater number of varieties, for Summer, for Fall and for Winter, but if he is planting for commercial purposes, he will plant fewer varieties, and such varieties as are in demand in the markets. The ideal apple for the large orchardist is one possessing the following traits. Tree a strong, healthy, robust grower, straight in stem, with a well-spread open top, coming into bearing young, and producing uniform crops annually, with neither foliage nor fruit subject to fungus diseases, holding its fruit late in the season. Fruit medium to large, of good form, with highly polished red color, flesh yellow, crisp, juicy, with high flavor. Core small, keeping fresh and plump until Spring. An orchard made up of varieties possessing the above qualifications would be

a veritable bonanza to its owner. Are there any such orchards to be found? No. It is with orcharding as with dairying; there are always a few that do not come up to the standard. There has not been a judicious selection of varieties. The planter has been governed by personal likings or prejudices, or has been induced to plant on the recommendation of others, or some highly extolled variety has tempted him to experiment, or he has seen some especially fine apple at some fair or horticultural meeting that was praised by the exhibitor. One or more of these reasons has caused him to depart from the only true course, and plant only such varieties he knows possess the qualifications for profitable orcharding. I know the horticulturist who loves his business is a progressive fellow, and the temptation to experiment with new creations is often too great to resist, and he plants in most instances to his sorrow.

The accumulation of varieties of fruit within the last twenty years has been so great that to give a description only of those of real merit would require a large size volume. The main object aimed at in this bulletin is to bring to the notice of the novice in fruit raising the best varieties, those which practical experience has proven to possess real valuable qualities, and such that he can plant with the assurance of success. Nothing is more embarassing to the inexperienced than long lists, with great long classification; so I shall endeavor to abbreviate my list as much as is consistent, yet beyond doubt many may think that list might have been made shorter. But this State is large, the climate and soil conditions vary greatly, various tastes and circumstances of individuals are to be provided for. One individual might be satisfied with one dozen suitable varieties, while another wants fifty or more varieties.

CLASSIFICATION.

We name varieties of fruit in order that we may speak and write about them. We consider a name a definite thing; therefore a variety should be definite or definable, but this is not a fact. there is no true standard or measure to constitute a variety, as they frequently vary or change through the influence of climate or other agencies. The King raised in Susquehanna county differs so much in external appearance, shape and markings, from those raised in Berks county, or in portions of New York State as to confuse the ordinary grower; the same with the Smokehouse and the Pennsylvania Vandavere as grown in different localities are classed as distinct varieties, yet when both are grafted on the same tree they are so alike as to be identical. A new variety may be given a name, this variety may become widely disseminated, and become so different in type that they might be classed as two distinct va-

rieties, both bearing the same name, environments have changed the type yet they all originally came from the same stock. These remarks are made for the purpose of pointing out the fact that certain apples and other fruits raised in widely different places may not agree in every respect to the descriptions given in this

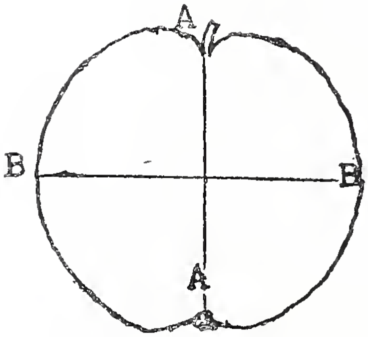


Fig.-41 Round.

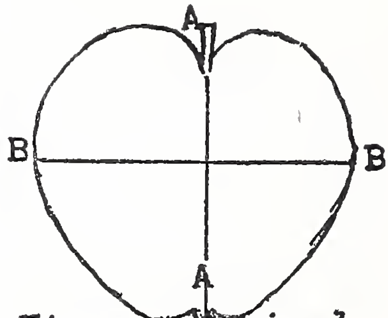


Fig.-42 Conical.

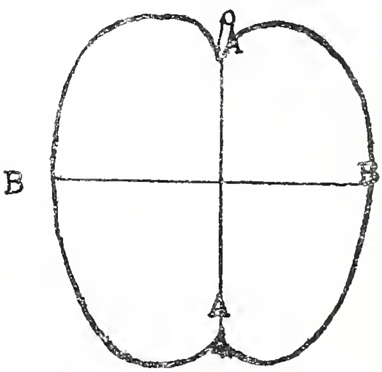


Fig.-43 Oblong.

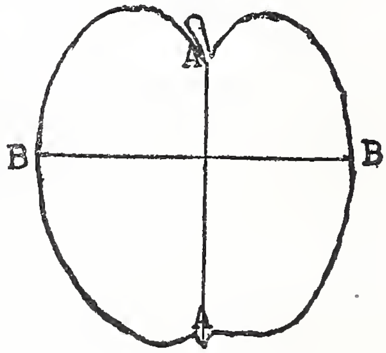


Fig.-44 Oblongconiç.

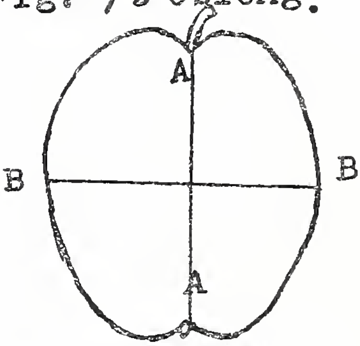


Fig.-45 Ovate.

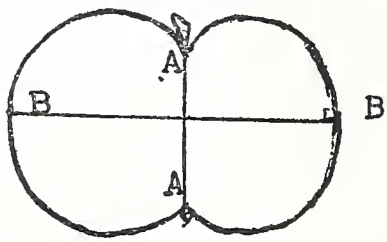


Fig.-46 Oblate.

work. A work of this size will not permit of entering into details in the description and characterization of fruits. In arranging varieties alphabetically as will be done here, only descriptions are of value, that are easily understood as we describe only what we see. If we were writing a classical work for expert pomologists

then we would enter fully into the classification and characterization of the various fruits. If such is wanted we will refer the reader to standard works such as Downing's or Warder, on the apple, or American Fruit Culture by Thomas, etc.

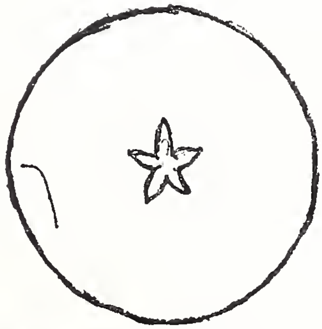


Fig.-47.Regular.

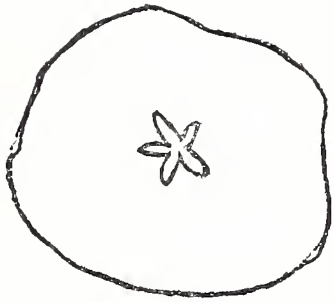


Fig.-48.Irregular.

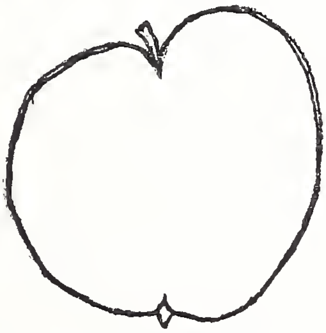


Fig.-49.Unequal.

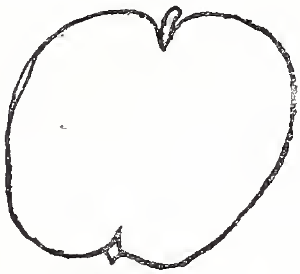


Fig.-50.Lopsided.

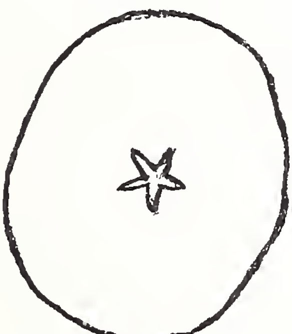


Fig.-51.

Compressed.

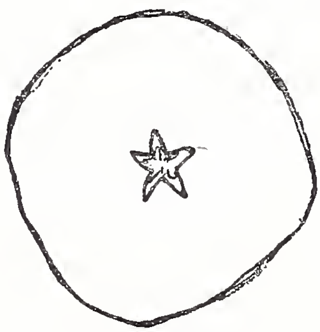
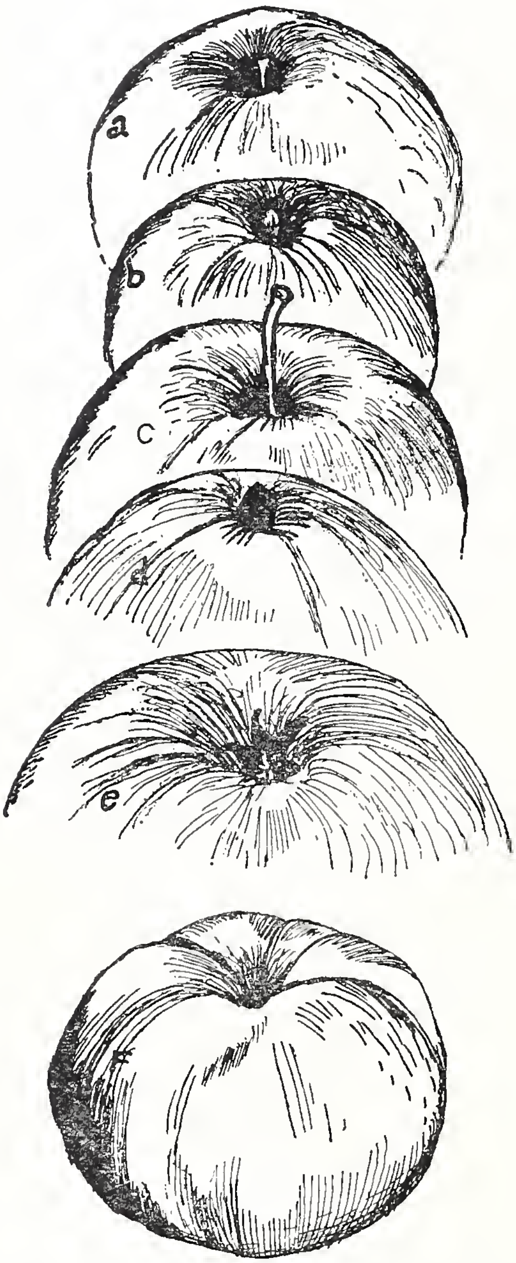


Fig.-52.

Quadrangular.

Before describing the varieties, I will insert several cuts illustrating the form and distinguishing features by which we describe fruit. Form is one of our most permanent characters; though subject to modifications, familiar with the peculiar outline of a variety.

By referring to the illustrations, it will be observed there are cross lines representing the two diameters referred to in classification by form; the vertical or axial diameter from base to apex A. A. The transverse diameter B. B. running at right angles from



Cavity narrow and deep in-a.

Stem short.

Cavity narrow and shallow in-b.

Stem very short in-b.

Cavity broad and deep in-c.

Stem long and slender in-c.

Basin small and shallow in-d.

Calyx or eye closed in-d.

Basin broad and deep in-e.

Calyx or eye is open in-e.

Basin corrugated or furrowed in-f.

Fig. 53. Distinguishing terms used in describing fruit.

the vertical The form may be round or globular as in Fig. 41, when it is nearly spherical. The axial and transverse diameters being nearly equal, as in the Fameuse.

CONIC or conical, indicates a decided contraction from the transverse diameter toward the apex, as in Fig. 42, as the American Golden Russet.

OBLONG.—That the axial diameter appears the longer, though in reality it is often no longer than the transverse, Fig. 43, as the Porter and Jonathan.

OBLONG CONIC.—That the outline also tapers rapidly toward the eye as in Fig. 44.

OVATE.—Means egg shape, tapering at both ends, Fig. 45, as the Spitzenburg.

OBLATE.—Flattened, when the axial diameter is the shorter, Fig. 46. When these forms are described evenly about a vertical axis as shown by a section of fruit cut transversely across the axis, the specimens may be

REGULAR.—As in Fig. 47, or it may be

IRREGULAR.—As in Fig. 48, or

UNEQUAL.—As in Fig. 49, or

LOP-SIDED, as in Fig. 50, as in the York Imperial, in which case the axis is inclined to one side.

COMPRESSED.—When the fruit is flattened at the sides, Fig. 51.

QUADRANGULAR.—As in Fig. 52.

BASIN OR APEX.—Consists of that portion fartherest from the stem. In the apple or pear it is commonly called blossom end, and is more or less depressed, and is therefore termed basin. In the description of fruits, the peculiar characteristics of form of the basin serve as distinctive marks of value as they are permanent, the basin, according to its form, is called deep, as in Fig. 53—e; shallow in d.

The basin in some fruits is very apt to crack, this does not go through the skin but resembles the cracking of a piece of dry leather when bent; it receives the name of leather crack. This is a valuable distinguishing mark as very few varieties have it.

The basin with the calyx constitutes the eye, the calyx rests in the middle of the basin. It is sometimes spoken of as the blossom. The calyx may be large or small; it may be composed of short or long segments, it may be closed, open, or half open, and in many instances the segments fall off entirely. Fig. 53 shows the calyx closed in d, and open in e. The basin is very rarely marked with russet or any other coloring different from the body of the fruit. Should such varieties occur they should be mentioned in giving description of the fruit.

CAVITY.—This should also be studied carefully. The cavity is the depression about the stem and in which the stem is inserted. This is the most distinguishing characteristic feature of the apple, and is equally distinct and interesting. In some pears, special at-

tention should always be given to it. The depth of the cavity should be noticed first, next the breadth, then the inclination of the sides, which may be rounded, sloping, abrupt, or broadly flaring; deep, shallow, regular or irregular, wavy, even or uneven, and even lipped when a portion of the flesh protrudes against the stem. Fig. 53 shows cavity narrow and deep in a, narrow and shallow in b, broad and deep in c.

The cavity frequently shows special markings or colorings, the most common one is of russet, which is often the case when the balance of the fruit is perfectly smooth and glossy. The cavity may also be green, when the body of the fruit is distinctly of a different shade, often the green and russet are mixed as to make it green russet. Occasionally the cavity has special striping which are distinctive marks.

THE STEM naturally claims attention in the description of the cavity. It is long or short, slender or stout, sometimes clubbed by a swelling on the side, as in the Krauser, and some others, though rare, they form striking characteristics of certain varieties.

COLOR. This is often difficult to describe, yet it is a feature that greatly aids the pomologist in distinguishing varieties.

There are various tints of green, yellow and red met with in apples and pears and it is a great satisfaction to be able to distinguish and describe these tints.

The manner in which the color is distributed over the fruit may be described with greater accuracy, it may be a mere blush on one cheek, or it may extend all over the side. It may be splashed upon the ground color, and the stripings may be fine and regular. Often two shades of red are combined in the coloring of an apple, both on a ground color of green or yellow, shades may be described as yellowish white, pale yellow, yellow; and deep yellow. The addition of red produces orange, orange yellow, orange red, shades of red, clear red, crimson, purple, violet and reddish brown.

Fruit may be striped, streaked, marbled, bloched, clouded, splashed, mottled, dotted and spotted. Dots are very characteristic on some fruits, especially the apple; they vary in size, in number and in color. In color they may be white, gray or russet. In form they may be round, irregular or areolar. These are small dots with a russet center surrounded by a circle of white or gray.

THE BLOOM is a waxy, whitish substance covering the outside of the fruit. It cannot be recognized as a distinguishing feature, as it varies according to the climate in which it is grown, and may be described as scant, moderate or abundant.

THE SKIN may be thick or thin, tough or brittle.

THE FLESH.—Its color should first be mentioned, next its tex-

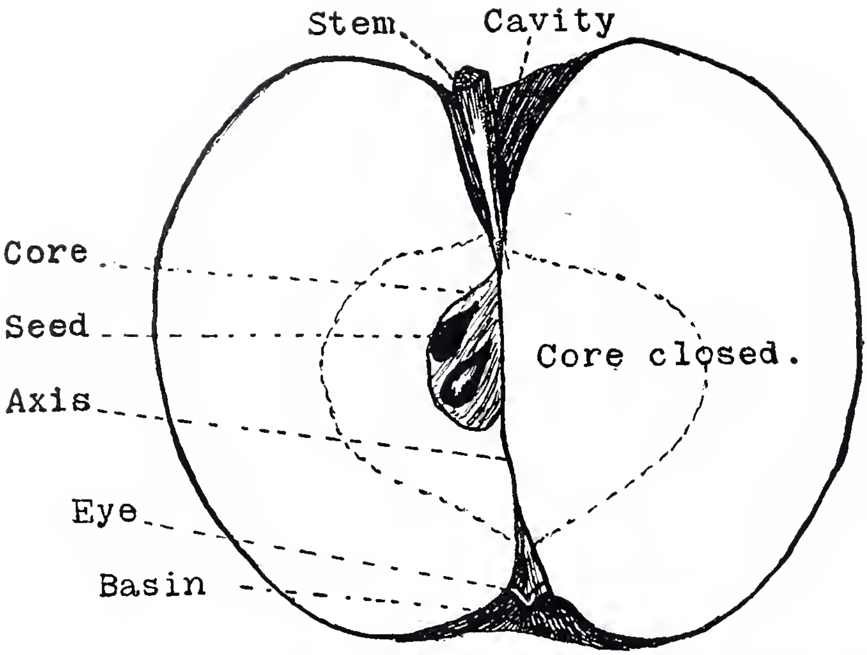


Fig. 54. Fruit large, globular, angular. Basin medium, plaited. Eye small, closed. Cavity deep, acute, brown; Stem medium long. Core irregular, closed, clasping; Axis short; Seed dark, pointed, imperfect.

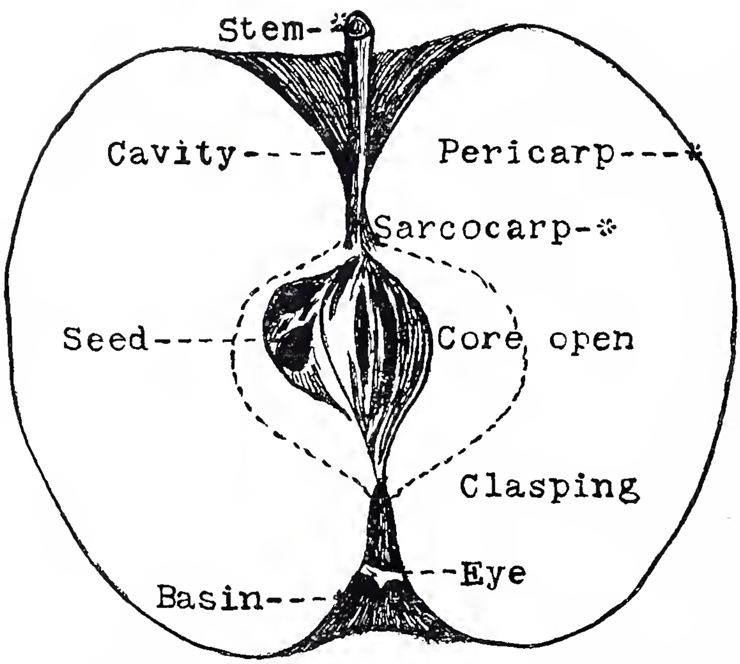


Fig. 55. Description of characters of the apple. Large, globular, somewhat flattened, or conic truncated, rather angular. Basin medium, abrupt, wavy; Eye medium long, closed. Cavity deep, wide, wavy; Stem long, curved. Core medium, open, clasping; Seeds numerous, angular, dark.

ture, this may be hard or soft, coarse or fine grained, crisp, spongy, granular or woody. It may be dry or juicy. In pears it is described as melting or buttery.

THE CORE may be large or small, it may be open or closed, it may be clasping, depending upon its relation to the sunken tube of the calyx.

SEEDS.—Numerous or otherwise, they are long or short, accuminate, rounded, flat, angular, imperfect, plump, large or small. They may be yellow or brown, dark or black, and their shades are distinctive, often enabling the pomologist to decide the variety when others are not sufficiently marked.

Figures 54 and 55 show the various parts of an apple, the cavity, basin, eye, core, seed, axis, the core open and closed, or American Fruit Culture by Thomas, etc. It is not presumed that the following list is perfect, even as far as it goes. No individual possesses such thorough knowledge of the various soils and climatic conditions in each individual county, or the varieties of fruits best adapted to them, as to recommend with infallible correctness special lists for each locality. There are certain rules by which we may in the main be guided, but local conditions often interfere with these, when reliance must be placed upon the experience and reports of others, and these are always liable to be biased by tastes or prejudices. These things have been kept in view, and wherever recommendations are made beyond our knowledge, they are based upon the most reliable authority to be obtained, and it is hoped it will be found beneficial to the grower intending to plant commercially or otherwise. In making this list, I propose leaving all varieties (regardless of the qualities they possess for other fruit sections) which are not adapted to any of the sections of Pennsylvania out of the list. I will describe varieties alphabetically, placing them in three classes, Summer, Fall and Winter.

SUMMER APPLES.

Class 1.—Benoni. Origin, Massachusetts. This handsome and delicious early apple is a native of Dedham, Mass. Owing to its good qualities its culture is widely extended and it is a favorite whereever grown. It does not ripen as early as some, but as a dessert fruit there are none of the early apples that excel it. The tree is small, upright, close, productive, early bearer, fruit small to medium, round, somewhat angular, irregular. Surface smooth, yellow, covered, mixed red, striped scarlet and carmine, dots minute. Basin wide, abrupt, eye large, open or closed. Cavity acute, wavy, brown, stem medium, green, often stout. Core small, closed, meeting at the eye; seeds angular, dark. Flesh yellow, fine grained, juicy; flavor rich, sub-acid, spicy, quality best; use dessert, kitchen and market; season, July and August, delicious and profitable.

Sweet Bough, Origin, American; a native fruit much admired as an early sweet apple. Tree moderately vigorous, compact, good bearer. Fruit round, conic, regular, very light. Surface smooth, white or pale yellow, dots minute, basin rather shallow, eye small, core regular, neatly closed, seeds medium, flesh white, very soft and juicy; flavor very sweet when ripe, quality only good; use market and dessert, season July and August.

Early Strawberry. Origin, New York; tree a moderate, upright grower, an abundant bearer, fruit small, roundish, slightly conical, skin smooth, yellowish, striped, shaded and mostly covered with red; flesh white, tinged with red next the skin, tender, sprightly, pleasantly sub-acid, perfumed, quality very good, valuable for orchard or garden.

Early Harvest. Origin, American. This native apple is a general favorite in Pennsylvania, and does well throughout the State. It is planted more generally for family use on account of its excellent dessert qualities. As a commercial variety it is no longer as popular as formerly, as it is prone to be defective, watery at the core and when ripe liable to crack upon and get mealy. Tree a strong growing, vigorous spreading tree; the limbs are very strongly attached to the tree by a shoulder or ring surrounding the limb at its base. Medium early bearer, very prolific in alternate years, fruit medium, regular, oblate, surface smooth, clear waxy yellow, very rarely blushed, dots numerous, minute, green, basin regular, narrow, abrupt, eye small, closed, cavity, wide; stem, short; core, large, round; seeds, large; flesh tender; breaking juicy, acid to sub-acid; agreeable; quality good. Season July.

Fanny. Origin, Pennsylvania. Tree a vigorous grower, spreading and very productive. Fruit medium in size; roundish, oblate, one of the most beautiful early Fall fruits; color, dark rich crimson; flesh, tender, white, juicy, sub-acid, fine flavor; for family use. Should be in every family orchard.

Golden Sweet. Origin, Connecticut. Tree a good strong grower, an early bearer and very productive. Maybe somewhat tender in the coldest sections of the State. Fruit large, roundish, slightly flattened, greenish, becoming pale yellow, stem an inch or more long; cavity, accuminate, basin moderate; flesh yellow, very sweet, of moderate quality. The fruit is always fair. Season, Midsummer.

Red June. Origin, North Carolina. Tree a vigorous upright grower, a good bearer, fruit rather small in size, oval or conic, purplish red on yellow ground, stem variable, calix closed, flesh tender, juicy, brisk, sub-acid. Early Summer.

Red Astrachan. Origin, Russia. Tree vigorous, upright, productive and hardy. One of the most widely known Summer apples on the list, as well as one of the most profitable orchard sorts, rather

tart for dessert. This fruit seems to be adapted to every state where apples grow, even in Florida where apples do not thrive. This apple is one of the exceptions, and next to the Jennings Florida is the most productive apple in the extreme South. Fruit large, roundish, nearly covered with deep crimson and a thick bloom; flesh tender, juicy, rich acid; basin medium, regular; eye small, closed; cavity shallow, regular, stem long, yellow; core, regular, closed; one of the best early market apples of the season. July.

Summer Queen. Origin, New York. This fruit was once very popular in Eastern Pennsylvania, but like some other varieties it seems to have run its course. In sections where it does well, it is a profitable late Summer apple. Tree a moderate grower, but no longer productive in most sections of Pennsylvania. Fruit large. conical, striped and shaded with red; flesh whitish yellow, very aromatic, rich and agreeable; a popular market sort and for dessert.

Townsend. Origin, Pennsylvania. Tree a good grower but rather a shy bearer. Fruit medium, oblate, pale yellow, striped with red, thin bloom; flesh white, tender, mild, agreeable sub-acid, a valuable market sort where it can be raised. Unprofitable for orcharding.

William's Favorite. Origin, Massachusetts. This is a very popular market apple and is raised quite extensively in Maryland, Delaware and New Jersey. It does fairly well in Southeastern Pennsylvania. The tree is a moderately vigorous grower, upright and a good bearer of beautiful highly colored apples; fruit medium, roundish, oblong; light and dark red; flesh yellowish white streaked with red; mild sub-acid; dots none; basin abrupt, folded; eye medium, closed. Cavity wide, shallow; stem, long and slender. Core large, quality poor. Season July and August.

Yellow Transparent. Origin, Russia. The last on the list but the first in the estimation of the cooks. There is no apple known to-day that can excel it for pies and tarts, and for making sauce it stands far ahead, making a smooth, white, rich-flavored sauce. Tree a stout, strong but not rapid grower, of an upright habit, a remarkable early bearer, enormously productive. Fruit above medium in size, roundish flattened, slightly conical; color white at first, turning to clear pale yellow; flesh white, tender, juicy, sprightly sub-acid; if left hang on the tree too long the fruit cracks open, becoming dry and mealy; the fruit is very tender and cannot be shipped to distant markets as it bruises badly, but for a near market it is the peer of early cooking apples.

There are many more varieties of Summer apples, some of them of excellent quality, and very productive in localities to which they are adapted, but the varieties that are comprised in this list, are those best adapted to the different sections of Pennsylvania.

AUTUMN APPLES.

These comprise apples that mature and are in an edible condition from the middle of August to the middle of November. Apples of this class that are good for dessert and of fine appearance are in good demand, and often bring better prices than Winter apples. During this period there is often a great scarcity of eating apples, the Summer fruit of different kinds are over, and the Winter fruit is not in condition. We have on the list a great many very good varieties.

Alexander. Origin, Russia. This apple does fairly well in most of the sections of the State. The tree is a medium sized spreading tree, an early bearer and moderately productive, but with us falls badly. This seems to be one of the principal points of weakness. Fruit is large, very handsome; conical surface, smooth, pale yellow, striped and splashed distinctly with bright red; dots minute. Basin medium; eye small. Cavity deep, narrow; stem medium to short; stout; core wide, regular. Axis short. Flesh whitish, breaking, not fine grained; quality scarcely good; season August and September. Uses, cooking.

Cornell's Fancy. Origin, Pennsylvania. Tree a vigorous grower and enormously productive. Must be picked before it gets fully ripe, as it cracks badly, and gets mealy. Fruit medium size, oblong, conical; yellow, shaded with crimson red; flesh white, tender, crisp, juicy, pleasant sub-acid; use dessert, and for nearby markets.

Duchess of Oldenburg. Origin, Russia. This apple is cultivated in the Northwest quite extensively; owing to its extreme hardiness, it is planted in sections where the Winters are very severe. Tree medium size, round headed and moderately vigorous, productive. Fruit medium, regular roundish, oblate; surface smooth, waxen-yellow, partially covered with distinct and regular stripes and splashes of brilliant red and carmine; often a light bloom. Basin regular, pretty wide; eye large, closed; cavity regular, acute, stem medium to large rather slender. Flesh white, tender, juicy; sour, suitable for cooking, poor dessert, though very attractive; especially adapted to the northern and western parts of the State. Does not do so well in the southeastern portion.

Fall Pippin. Origin, American. This apple is valuable over a great extent of country, where the extremes of temperature are not so great. The delicious quality of this apple appeals to every one. Tree is very vigorous, large spreading, open headed; not an early bearer, or very productive until it attains age. Fruit very large, handsome, globular, truncated, making it cylindrical, regular; surface smooth rich yellow, rarely blushed in the South, frequently so in the North; dots minute, gray. Basin deep, abrupt, regular; eye large, open; segments short. Cavity wide, regular, or narrow,

deep; stem long. Core large, regular, closed, meeting at the eye; seeds pointed, often imperfect; flesh yellow, breaking, compact, very fine grained; flavor acid, becoming sub-acid, aromatic, delicious; quality best, for dessert, kitchen or market; season September to December.

Gravenstein. Origin, Germany. In many sections this is considered one of their best and most profitable Fall apples. When grown to perfection and placed on the market it brings good prices. Its beauty and quality are its recommendation. It succeeds in every section of the State. Tree is vigorous, spreading, productive. Fruit large, oblate, somewhat conical; surface smooth, waxen, yellow, shaded and marbled with red; flesh yellow, tender, fine grained, breaking, juicy; flavor sub-acid, aromatic; quality best. Basin medium, eye small, closed, Cavity deep, regular, stem short. Core regular, globular, pointed toward the eye. Season August and September.

Jeffries. Origin, Pennsylvania. This delicious Chester county apple is one of the best of its season. Tree is healthy, sufficiently vigorous, with slender shoots and bright green foliage. A very productive early bearer. Fruit medium to large, oblate, regular; surface smooth, yellow, mixed and splashed with crimson; dots large, scattered, yellow. Basin wide, regular; eye closed. Cavity medium, regular, stem medium to long. Flesh yellow, breaking, fine grained, juicy; flavor sub-acid, aromatic, delicious; quality best, profitable for table or market. Season August, September and October.

Jersey Sweet. Origin, New Jersey. Tree moderately vigorous, very productive. Fruit medium in size, roundish-ovate; greenish yellow, washed and streaked with red, often covered with red stripes of dark and pale red; flesh white, tender, sprightly, sweet; should be picked early or they become mealy; use dessert and market.

Maiden's Blush. Origin, New Jersey. This beautiful and profitable fruit has received the unqualified praise from thirteen out of eighteen states that reported to the American Pomological Society. As a market fruit there are few that can compare favorably with it. The tree is very hardy with a spreading head, an early and abundant bearer. Fruit is medium to large, roundish-oblate; pale lemon yellow, with a light crimson cheek next the sun; flesh white, tender, sprightly, brisk sub-acid, an excellent cooking apple, requiring but a short time to be reduced to a delicious pulp or light color. Season, August and September.

Melon. Origin, New York. Tree vigorous, spreading, round headed. Fruit large, oblate, somewhat conical, angular; surface smooth, waxen yellow, nearly covered with marbled and mixed

scarlet, striped distinctly with darker shade; dots minute. Basin wide, medium depth; eye medium, open. Cavity deep, acute, wavy; stem medium. Core regular heart shaped, wide, partly open, seeds numerous; flesh yellow, tender, fine grained, juicy; flavor acid, subacid aromatic. Quality almost best; use dessert, kitchen and market. Season October and November. In the northern portion of the State this would be classed as early Winter, for it will keep until in December.

Mother. Origin, Massachusetts. Tree a moderate grower, slow coming into bearing. Not very productive. Fruit medium to large, oblong, regular, surface shaded red on yellow with close fine stripes of red; dots minute, basin medium, regular or plaited; eye long, small, closed. Cavity acute, regular or wavy; stem long, slender. Core medium turbanate, regular, closed, seeds numerous; flesh yellow, crisp, very fine grained, juicy; flavor sweet, very rich, vinous, aromatic; quality best; use dessert; season late Fall or early Winter.

Paradise Sweet. Origin, Pennsylvania. Tree upright, vigorous, productive. Fruit large, oblate-globular, regular; surface greenish yellow; dots numerous, large, white. Basin shallow, wide, folded; eye small, closed; cavity deep, regular, acute, green; stem long; inclined; core medium, regular, round; seeds plump. Flesh yellow, melting, juicy. Flavor rich, sweet; dessert and kitchen; season August and September.

Porter. Origin, Massachusetts. Tree vigorous, healthy, productive; fruit rather large, oblong, somewhat conic, often truncated; surface smooth, yellow, often faintly blushed; dots few, sunken; basin abrupt, folded; eye large, closed; cavity acute, wavy; stem medium; core medium, oval, regular, closed; seeds numerous, plump; flesh yellowish white, breaking, tender, juicy; flavor acid to subacid; quality good to very good, highly esteemed for table or market; requires good rich soils.

Summer Rambo, Western Beauty, Big Rambo, Ohio Beauty. Origin, not known but an apple of so many sterling qualities it must have originated in Pennsylvania where it is extensively grown. Tree is extremely vigorous, spreading, open headed, productive, a very early bearer. I have trees on the Paragon Fruit Farm ten years old, that have a stem diameter of eleven inches, with tops spreading over thirty feet and bearing annual crops for several years. Fruit is large to very large, frequently five inches in diameter. Beautiful, regular, oblate, not disposed to rot, except when eaten into by the birds which are very fond of them, which vouches for their quality, as they are excellent judges; surface smooth, pale yellow, partially covered with mixed red, striped, and often distinctly splashed with bright red; dots numerous, gray prominent; skin quite thin. Basin wide, regular sometimes cracked open; eye

large, closed. Cavity wide, regular, green, and partly brown; stem variable. Core large, nearly closed; seeds numerous; flesh light yellow, almost white, brittle, tender, juicy, almost melting, never water cored; flavor sub-acid, vinous, delicious, satisfying; quality best either for table or cooking, for the latter purpose they may be used when half ripe; they may be gathered in August and house-ripened, but their proper season is September; if well cared for they may be kept till December. This variety cannot be too highly recommended, to be planted for family use or commercially.

Senator, Oliver Red. Origin, Arkansas. This is one of the new applicants for public favor. It attracted considerable attention at the World's Fair, Chicago. It is extensively grown in Western Arkansas. This is one of a large number of Arkansas varieties planted on the Paragon Fruit Farm. We find the tree a moderate grower, forming a fine open head. It is an early, and shows indications of being an annual bearer. Fruit medium to large in size, roundish-oblate, some specimens nearly flat; stem medium, short and stout; cavity regular, medium, sometimes slightly russeted; basin wide, deep; color deep yellow ground, covered with bright red. One of the most beautifully colored apples; surface covered with large russet dots; skin thick, flesh yellow tinged with red, fine grained, juicy; flavor mild sub-acid; quality very good; season, at place of origin, early Fall. With us it is a late Fall and early Winter; a valuable apple for fancy trade. I do not think the tree is sufficiently hardy for Northern and Western Pennsylvania.

Smokehouse. Origin, Pennsylvania. There is considerable dispute whether this and the true Vandervere are identical. I shall treat them as one, as I have never yet met an expert who was able to distinguish one from the other, often calling one specimen a Smokehouse and another a Vandervere, when both were taken from the same tree. The tree is vigorous, large spreading, very twiggy and drooping, foliage bright yellowish green. Fruit medium to large, oblate or globular-oblate, regular; surface smooth but having raised warts of a yellow russet color; yellow, mottled and striped with light red; dots large, yellow, indented; often has a gray appearance over the whole surface. Basin wide, regular, not deep; eye small, closed; cavity wide, regular; stem long and slender; core regular, medium; seeds numerous; flesh yellow, breaking, granular, juicy; flavor highly aromatic; sub-acid; quality almost best for dessert, and as a cooking apple it stands in the front rank. Season October to January. This apple is a general favorite wherever grown, and does well in every part of the State, as a market variety it has few equals.

Stump. Origin, New York. Tree upright, stocky grower and abundant bearer. Fruit medium, roundish-conical, skin white,

striped and splashed with crimson; flesh white, tender, juicy, with a pleasant sub-acid flavor. Season early Fall. A favorite market variety where known, a late bearer at Paragon Fruit Farm. I cannot recommend it for Eastern Pennsylvania. Claimed to do well north of latitude 40.

Twenty Ounce. Origin, Connecticut. Tree a strong straggly grower; fruit large, regular; surface greenish, more or less mottled and striped with dull red; core large; seeds numerous; flesh yellow-white, breaking; flavor acid with a peculiar aroma; quality very poor; use for kitchen only; season November and December. This variety does fairly well north of latitude 41, but I would not advise planting, when there are so many more valuable varieties.

Wealthy. Origin, Minnesota. Tree somewhat dwarfish to medium size, moderately vigorous, form upright spreading or roundish, open and somewhat drooping; fruit above medium to large when well grown, but when overloaded (which they are apt to be as they are extremely productive) and on old trees, they are apt to be small; form roundish-conical; slightly flattened at the base; stem usually short to medium; basin medium in depth; cavity decidedly acuminate, rather deep; skin thin, tough, pale yellow, or greenish, blushed and marked with narrow stripes and splashes of red, deepening in highly colored specimens to a brilliant red, very attractive; dots numerous, small; flesh whitish, sometimes stained with red, moderately fine grained, crisp, tender, very juicy, agreeable sub-acid, sometimes aromatic, good to very good; season October to January. This variety is particularly valuable for cold climates, because the tree is very hardy. The fruit sells very well, being bright red, and good in quality for dessert or culinary uses. To keep this fruit up to the standard in size the fruit should be thinned on the tree, and the land kept fertile. Where there is a good market for Fall apples this variety, properly managed, is very valuable.

Wolf River. Origin, Wisconsin. The tree moderately vigorous, spreading, open and inclined to droop; very hardy; a biennial or sometimes annual cropper; yielding moderate good crops. The fruit is large, shapely and highly colored, often sells well on account of its attractive appearance. It has largely superseded Alexander in the West, flesh slightly tinged with yellow, firm, moderately coarse, tender, juicy, sub-acid, a little aromatic, fair to good; season September.

WINTER APPLES.

In the well-selected orchard the large proportion of the trees are Winter varieties. A limited amount of Summer and Fall fruit should be planted that a continual supply may be had the year round, but the main dependence of the commercial orchardist are

such varieties that mature and can be held by cold storage or otherwise until the Summer fruits of various kinds which glut the market, are over.

Aikin, Aikin's, Red. Tree moderate strong, upright grower, when young spreading with age. A young bearer, very productive, fruit small to medium, round, inclined to conical, regular; surface smooth, with high polish, yellow, over-spread with solid red; dots numerous, white; flesh firm, yellow, breaking, very fine grained, juicy; flavor sub-acid, rich, aromatic, delicious; quality best; uses dessert. This high grade apple unless thinned is liable to over-bear, breaking the limbs and reducing the size of the fruit; rather small for a market apple.

American Blush. Origin, Massachusetts. There is some confusion between this variety and the Hubbardston Nonsuch. It is one of those cases where it takes an expert to point out the difference, and he is not sure of his grounds; so when we have described one, both are described. I do not believe there is an apple in the entire list, unless it be Stayman Winesap, that will make as much money commercially as this one. On the Sunnyside Fruit Farm I planted in 1879 fifty trees of this variety, and it has produced more fruit and brought more income than three times the number of trees of any other variety.

The trees bear so heavily that they grow humpbacked. The tree is a strong, vigorous grower, bears moderately young; fruit always large, handsome, round, somewhat ovate, tapering both ways from the middle, regular, produces less imperfect fruit than almost any other variety; surface uneven, yellow, covered with mixed red and broken stripes, presenting a rich brownish appearance; dots scattered; basin abrupt, wide, regular, leather cracked or russeted or both; eye small, open; cavity wide; stem medium or short. Core large, heart shaped; seeds few; flesh yellow, breaking, fine grained, juicy; flavor, sub-acid, rich; quality very good; season November and December. Keeps well in cold storage, but in severe climates it should be top worked on some very hardy trunk as Northern Spy or preferably Mammoth Black twig.

Arkansas, Mam. Blk. Twig.—Origin, Arkansas. There is considerable confusion between this variety and the Paragon, which will be described later. I have about one hundred of each of these varieties planted at the Paragon Fruit Farm that are now ten years old. Although there is a very strong resemblance, I am satisfied they are distinct. The Paragon is a little more spreading, the fruit is a little flatter, more solid brownish red at the base, and the flesh is rather more of a greenish yellow tint. The Mammoth Black Twig tree is slightly more upright, the fruit is a little more inclined to conical, yellow with light and dark red stripes, flesh yellow.

The tree is one of the strongest growing trees in the list, does not come into bearing very early, but improves with age. Many of my ten-year-old trees will have from eight to ten bushels per tree this season. The fruit is large, roundish, conical, smooth, yellow, washed with red, having a few indistinct stripes; stem short, slender; basin medium in size and abrupt; dots medium size, yellow; cavity, large, deep, flaring, russet; eye small; skin thick and tough; flesh yellow, moderately fine grained, breaking, juicy, sub-acid, very good late in the spring. It is a very long keeper. I have kept this fruit until June.

Baldwin.—Origin, Mass. This variety has been planted more extensively than any other variety. Every one planting an orchard for family use or for commercial purposes thinks the Baldwin must be included in the list, never pausing to consider whether it is adapted to their location; and as a result thousands of planters have been disappointed. The Baldwin is a very profitable apple north of latitude 42, where all of its good qualities are fully developed. In the northern and western parts of Pennsylvania it is productive, but must be picked before it is fully matured or colored or it drops from the tree before gathered. In the southern and southeastern portions of the State it becomes a fall apple in every sense, dropping from the tree before its good qualities are developed. There are exceptional localities at high elevations and on the clay soils where it does fairly well even here. Tree very vigorous, upright, spreading, an early and abundant bearer (where at home); fruit large, rounded, narrowing at the eye; yellow ground, nearly covered with a rich bright red, especially on light soils; flesh yellowish white, crisp, juicy, pleasant sub-acid; an all winter fruit; quality good, a very popular market variety.

Beach.—Origin, Arkansas. This variety has been very extensively advertised and highly extolled by a western nursery, under the synonym of Apple of Commerce; it is also known as Lady Pippin and Richardson Red; the last is its original name. The tree is a good grower, early bearer and very productive of beautiful highly colored fruit with a heavy bloom, but the fruit is too small and of too poor quality to ever become popular in Pennsylvania, where we know what good fruit is. Let it alone.

Ben Davis.—Origin, Kentucky. (Synonym, New York Pippin.) This is a variety that in a few years will require a new name every time a barrel is sold, and yet it has been and is being more extensively planted than almost any other variety, especially in the southwest, where thousands of acres are being planted commercially; and I am sorry to say that many of our Pennsylvania friends have formed its acquaintance and are on good terms with it; but if used in their own household it is as a last resource. It is a very popu-

lar and economical variety with hotel keepers—a peck going a long way; few patrons having the hardihood to bite into one. Occasionally a greeny will bite.

Tree hardy, vigorous, upright, spreading, productive, bears young, blooms late; fruit medium to large, roundish conical, yellow, mostly overspread, splashed with red; flesh white, occasionally tender, mostly leathery, spongy; quality poor; few people would care to be caught with one in their pockets. Uses, to sell to the Italians as bait for suckers.

Black Ben Davis.—Origin, Northwest Arkansas. Black Ben Davis introduced by a western firm under this name, are considered by experts to be the same as the Gano, Reagan and Etris. We have the Gano and the Black Ben Davis both in bearing at the Paragon Fruit Farm, both obtained from reliable sources, and if there is a difference we have so far failed to have any one point out the difference. Description will be given under the head of Gano.

Collins, Collins Red.—This variety has been introduced by the same western firm under the name Champion. Origin, Arkansas, introduced by Mr. George Collins about 1886. I planted this variety in the Paragon Fruit Farm, and though not a fruit of high quality it is proving fairly profitable, but the quality is not sufficiently high to place it beside fruit of higher merit. Tree is a moderate grower, of somewhat drooping nature like the willow twig; it is a very early bearer and enormously productive; fruit medium, form roundish oblate; stem long to medium; cavity deep, usually smooth, sometimes slightly russeted; basin large, regular, rather deep and abrupt; color yellow greenish ground, shaded and striped with red; surface covered with light dots; flesh solid, light yellowish, moderately coarse, juicy; quality hardly good; season late winter. If the planter places quality second, then the apple will prove valuable as a commercial variety.

Dominie (Wells of Ohio).—Origin, New York. This variety has a peculiar growth of tree that makes it conspicuous among others. Thrifty, making long, stout, brown shoots, which branch at the ends and form spurs along their sides, giving it a very straggling, open head, and bears its fruit crowded along the smaller branches. It is hardy, vigorous, productive; fruit large, flat, regular; surface yellowish green nearly covered with mixed red, and striped indistinctly with carmine; often vein russeted; dots scattered, yellowish gray, large; basin shallow; eye medium; cavity wide; stem medium to long, slender at point of insertion; fruit hard to gather, stem liable to pull from the fruit. Core regular, medium large; seeds numerous; flesh light yellow, breaking, tender, juicy; flavor slightly subacid, rich; quality very good; uses table, kitchen or market; season December to February and often until spring.

Evening Party.—Origin, Pennsylvania. This most excellent dessert apple is a native of Berks county, and wherever it has been introduced it meets with praise. Tree is a moderate grower and productive; fruit medium, regular, quite flat; surface smooth; color waxen yellow with mixed red, and carmine stripes; dots numerous, gray; basin abrupt ,regular, deep; eye small, close; cavity wide, deep, regular, brown; stem medium, green, slender; core small, regular, closed; flesh light yellow, very fine grained, tender, juicy; flavor sub-acid, aromatic; first quality the very best for dessert; season December and January.

Fallawater, Tulpehocken, Pound.—Origin, Pennsylvania. Found as a seeding growing along the Tulpehocken creek; first apple picked from the creek and called Fall-in-water. It is a general favorite throughout Pennsylvania and many Western states where introduced. It is gradually working its way to the front as a market variety. Tree is a strong, vigorous grower, attaining large size with age. It should be top-worked, as the wood is soft, and when root-grafted is very apt to be killed by the borers, as they seem to have a liking for this variety. It is enormously productive, large trees bearing from thirty-five to fifty bushels per tree, fruit very large. This is one of the prize apples at the county fairs, and apples weighing from 16 to 20 ounces apiece are common; form round, or oblate conic, regular; surface smooth, greenish yellow, often splashed crimson; large specimens covered with whitish veined marks; basin rather deep, regular; eye large, open; cavity deep, regular, brown covering the base of the apple; stem short, stout; core medium, closed; seeds numerous; flesh whitish, often greenish-white, light, tender, juicy; flavor very sub-acid, or sweet; quality good; there seems to be a sport from this, much flatter, color greenish, never blushed, quality not so good as the more conical variety; season of both November to spring; we frequently hold the conical variety until April without cold storage.

Gano.—An apple with many synonyms—Black Ben Davis, Reagan, Etris, Arkansas Belle. A fruit with so many titles should be of greater merit, but aside from its remarkable beauty it is but little better than the Ben Davis, and is not a variety to gain a reputation. Origin, Tennessee. Tree a healthy, robust grower, with a round spreading top; comes into bearing very young, and with proper treatment is an annual bearer, very productive; the bark is decidedly red, foliage large, dark green, and when laden with its immense crops of highly colored fruit forms a striking picture. Fruit medium to large, variable in form, sometimes round, mostly oblong-conical, tapering to the eye, very true; surface smooth, mostly polished, yellow, covered with bright red; basin shallow in large specimens, deep, abrupt, always regular; eye large, open; cavity deep,

acute, wavy, stem medium to long, slender, attached strongly to the tree, frequently pulls from the fruit. Core medium, regular; seeds large, plump; flesh whitish, breaking, tender, juicy; flavor mild sub-acid; quality poor; use market only; poor cooker, poor eater.

Gilbert. Origin, Tennessee, by Dr, Moore, also the introducer of the Paragon, which is often taken for Mammoth Black Twig. The Gilbert so closely resembles these two that all three might be classed as one, yet there is certainly a distinction, more marked in the growth of the tree than in the fruit. Dr. Moore considered the Gilbert as the most productive. Tree is a very strong grower, forming a beautiful round head, with limbs heavily shouldered where they join the trunk; not an early bearer. The trees on the Paragon Fruit Farm are nine years old and this is their first heavy crop. The fruit is large, round, somewhat conical; surface smooth, yellow, striped and splashed with red and carmine; dots distinct, large, gray; basin medium; eye small; cavity medium or wide, regular; stem medium, slender; core medium; flesh yellow, crisp, breaking; flavor sub-acid; quality good; uses dessert, kitchen and market; fruit does not drop; season January to June.

Grimes Golden. Origin, Virginia. In introducing this variety, Mr. S. B. Marshall, of Massilon, Ohio, conferred a blessing upon posterity that cannot be estimated. This beauty is among the apples what Seckel pear is among the pears—the standard of excellence. Tree vigorous, healthy, spreading and very productive; the tree comes into bearing at an early age. The one weak point in this variety is stem blight or canker; when trees are purchased from the nurseries root-grafted, they are short-lived, seldom living over twenty years; but this can be avoided by top working on some strong growing variety (Paragon or Mammoth Black Twig cannot be excelled for the purpose, as they form very spreading tops, limbs strong shouldered, top work when three or four years transplanted, and you will have trees for more than half a century), at the Paragon Orchard we have top worked more than half a hundred of this kind on the Stark stock. Fruit above medium, cylindrical, regular; surface yellow, vein russeted; dots numerous, minute; basin abrupt, folded; eye large, closed; cavity wide, regular, green; stem long curved; core small pyriform, closed; seeds numerous. Flesh yellow, firm, breaking, very fine grained, juicy; flavor sub-acid, aromatic, spicy, rich; quality very best; use dessert, market. There is such a demand for this fruit that buyers are willing to pay from ten to twenty cents more per bushel from the orchard than for any other variety. Season December to March. Does well wherever tried.

Heiges, Origin, Arkansas. This variety is comparatively new in Pennsylvania and farther north. I do not know of any except in the Paragon Orchards. Nurserymen do not grow them, and yet for all

purposes few varieties can compete with them. Tree is a strong, vigorous grower somewhat on the willow twig order, comes into heavy bearing young and produces enormous crops annually. I consider this a very valuable as well as beautiful apple. Fruit large, roundish, slightly conical; stem slender, medium to long; cavity medium sometimes russeted; basin shallow and small; color yellow ground covered with red, mostly highly colored; surface covered with minute dots, which are very thick near the calyx; flesh fine grained, rich, tender, juicy; quality very good to best; season November to January. I consider this variety profitable to plant commercially.

Highfill. Origin, Arkansas. A seedling of Ben Davis, a variety worthy of a better parent. Tree is a strong upright grower while young, forming a spreading, open head with age, comes into bearing very young, and very productive, annual bearer. Fruit medium to large; form roundish, conical; stem medium; cavity deep, accuminated, lipped and russeted; basin deep, narrow, abrupt; color yellow ground, splashed and covered with red, highly colored; heavy bloom; flesh white to yellow, tender; flavor mild, sub-acid, good; season late winter. This is a good market variety, because of its color and productiveness.

Hubbartston. Described under head of American Blush; they are identical. I prefer the name Hubbardston, and advise planting commercially.

Jonathan. Origin, New York. This is another one of those grand, good apples, once tasted, always wanted. It never begs for a market, even in seasons of so-called overproduction (should be called lack of distribution). It is one of those varieties that adapts itself to every locality. The tree is rather of a weeping nature; it should be top worked on some strong grower, when it comes into early bearing and produces enormous bi-annual crops. Fruit oblong, round, conic, truncated, regular; surface very smooth, waxy yellow, entirely covered with brilliant dark red mixed and striped; dots small; basin deep, regular, russet veined; eye small, closed; cavity acute, deep, regular; stem long, slender; core medium, roundish, oval; seeds numerous; flesh yellowish white, tender, breaking, very juicy; flavor sub-acid, aromatic; quality best. Use dessert, cooking and market; season December and January. Should be planted in the family orchard or commercially.

King of Tompkins County. Origin, New York. Next to the Baldwin is one of their most valuable apples. Wherever it can be successfully grown it is very profitable. It does very well in the northern counties of Pennsylvania, but in the southern section and east of the Susquehanna river it does not do well, unless well elevated, as it drops early in the season. Tree is a very rapid grower, forming a

large spreading head; the variety should be top worked, being short lived when root-grafted, subject to stem blight. Fruit is large, handsome, globular, irregular, somewhat conic; surface smooth, yellow, covered with deep red; flesh yellow, tender, juicy, rich, vinous, highly aromatic; uses dessert, kitchen and market. Season December to February. Valuable north.

Krauser. Origin, Berks County, Pennsylvania. This variety has gained considerable reputation locally. Tree is a very rapid, upright grower, forming a beautiful, symmetrical round head, needs considerable pruning while young, as it grows very branchy, not very early but a prodigious bearer; fruit small to medium, roundish, conical; color yellowish green splashed and striped with red; skin thick and tough; flesh white, tender, sprightly, sub-acid; quality good. Uses dessert, kitchen. Season December until May. This variety will never become popular as a market sort, its tough skin and soft flesh being objectionable.

McIntosh. Origin, Canada. This variety belongs to the Famuese group, but is adapted to a wider range of locality. The fruit is very attractive in appearance, of bright, deep red color and good size. The flesh is very tender, perfumed, delicious; too soft for shipping to distant markets, but very desirable for dessert and local markets; season where grown in elevated regions north of latitude 43 it will keep until midwinter, but as grown in northern Pennsylvania it will not keep later than October, but may be held in cold storage until the holidays, when their attractive appearance finds them ready sale at good prices. All the apples of this group are very susceptible to scab, which must be controlled by spraying; would not recommend planting this variety east of the Susquehanna or south of latitude 41 or on low lands.

Missouri Pippin. Origin, Missouri. This variety is not placed on this list on account of any valuable qualities it possesses, but rather as a warning against it; as it is highly recommended by many nurserymen to be planted commercially, as a filler between other varieties. I planted two hundred trees as fillers in the Paragon Fruit Farm. They certainly had every quality recommended except good quality; they were the most beautiful frauds I ever saw. I never saw even a boy who attempted to eat one but gave up in disgust. Not wishing to impose on an unsuspecting public I pulled them out. Tree is a moderate grower, very early and prodigious bearer; fruit small to medium, roundish oblate, whitish-yellow, striped and splashed with light and dark red; flesh yellowish, coarse, tough, subacid, poor; worthless in Pennsylvania.

Nero. Origin, New Jersey. Tree very vigorous, strongly branched, spreading, open, round headed, comes into light bearing early, but increases in productiveness with age Fruit medium in size, round,

truncated, sometimes flattened; surface smooth, yellow, nearly covered with stripes of light and dark red; dots minute, subjected to russeted warts; flesh greenish yellow, firm, juicy; flavor mild sub-acid to sweet; quality good; season December to March; a very good market apple, a great favorite with Delaware planters; has not proven profitable thus far at Paragon Fruit Farm.

Nottingham Brown. Origin, Pennsylvania. Tree a crooked grower in the nursery. Nurserymen do not like to raise it, too many poor trees, therefore not recommended by them; when top worked it is a vigorous spreading, open headed tree; comes into bearing very young; enormously productive; fruit large to very large, flat, regular, sometimes unequal surface, smooth, yellow; the base of the apple is nearly a solid brownish red with dark and light stripes toward the basin; dots large, scattered; basin rather shallow; eye medium; cavity large, somewhat open; flesh light yellow, breaking, tender, juicy; flavor slightly sub-acid; very good; excellent for table, kitchen or market. This fruit is proving very valuable at the Paragon Orchards on account of their annual crops of fine, large, showy fruit, just at a season when good fruit is scarce between the fall and winter fruit. It is well adapted to every locality where tried in Eastern Pennsylvania. I believe it worthy of trial throughout the State; perfectly hardy.

Northern Spy. Origin, New York. Tree very strong, upright, grown in the nursery, an excellent stock to plant for top working other weaker varieties. Very large and spreading with age. This variety does not come into good bearing under twelve or fifteen years. but is very productive when older; this is one of the leading apples in New York State and in the eastern and northern tier of counties of Pennsylvania, even as far south as Berks County it is a very heavy producer, but the fruit often rots badly on the tree. Fruit is large, flattened conical, angular; surface smooth, yellow, mixed and splashed scarlet or crimson; dots scattered, small; basin abrupt, regular; eye small, closed; cavity wide, regular, wavy, brown; stem medium to short; core large, irregular; seeds numerous; flesh yellowish white, breaking, granular, juicy; flavor acid, becoming sub-acid, aromatic, rich, spicy; quality best. Use, dessert, kitchen, and market. Season in Pennsylvania November until March.

Paragon. Origin, Tennessee. Introduced by Dr. W. L. Moore, Lincoln county, Tenn., about the year 1887. At one time considered identical with the Mammoth Black Twig, Arkansas, but now acknowledged as distinct. The tree is a very strong, robust grower, very spreading branches, stout, does not come into bearing so young, but trees in their tenth year at the Paragon Orchards from five to ten bushels per tree, their long pendant limbs bending to the ground. Fruit large to very large, roundish, conical, smooth, yellow, washed

with dark red; often solid at base with a few indistinct stripes; dots of medium size, yellow; cavity large, deep, flaring, russet; stem short, slender; basin medium in size and depth, abrupt; eye small, nearly closed; skin thick, tough; core medium, conical, clasping; seeds numerous; flesh greenish yellow, moderately fine grained, breaking, juicy, sub-acid, good. Season late winter. Large trees at Sunnyside Fruit Farm top worked eight years ago are very productive and finer than on young trees.

Pewaukee. Origin, Wisconsin. This apple is better adapted to the Northwest than to Pennsylvania; with us it drops too early and is not a good keeper; tree is vigorous and very hardy; fruit large, roundish-oblate, yellowish-green, striped and shaded with dull red, overlaid with a bluish bloom; flesh yellowish, coarse grained, firm, juicy; flavor sub-acid; quality poor; not recommended for Pennsylvania.

Rome Beauty. Origin, Southern Ohio. This variety when well grown in localities adapted to it is one of the most handsome and profitable varieties we have. Tree is a very thrifty grower, shoots rather long and slender, but forms a very large round headed tree, coming into bearing young, and produces heavy crops annually. This variety is seldom caught by late frosts, as it opens its bloom late. Fruit is very large, varying in form from oblate, roundish oblate to conical; always handsome and fair; surface smooth, pale yellow striped and mixed bright red, often very highly colored and polished; dots minute; basin wide, deep, regular; eye quite small, closed; cavity wide, wavy, green; stem long and slender. Core wide, regular, closed; flesh yellow, breaking; flavor sub-acid; quality good; one of the most valuable market varieties of its season; December to February. We esteem this apple very highly.

Roxbury Russet. Origin, Massachusetts. This variety, the Baldwin and the Rhode Island Greening were in former years considered the three standard apples of the country, and no orchard was complete without them, but all these have seen their best days and other valuable varieties are taking their place. There are yet favored locations in Pennsylvania where the Roxbury Russet continues profitable, but it is very much subject to codling moth and drops badly. Tree is robust, vigorous, spreading; fruit large, oblate, often lop-sided, sometimes conical; surface overspread with heavy brownish russet in the South; in Pennsylvania a bronzed light russet; dots minute, scattered; basin regular, wavy, green; cavity regular, pointed; stem medium, curved; core regular; flesh greenish yellow, breaking, granular, juicy; flavor acid; quality medium to good; uses market and cooking; season all winter.

Rhode Island Greening. Origin, Rhode Island. This is one of the old standards, and has always been a general favorite wherever it

could be grown; but it gives such poor satisfatcion in Pennsylvania, even in the northern counties, that very few trees are planted; instead of being a winter fruit it matures and drops in early fall. This variety is partial to sandstone soil, doing much better than in limestone soil. Tree is vigorous, crooked, spreading and would be very productive if fruit would hang to tree; fruit large to very large, varying in form from globular or round to flat; surface smooth, often russeted farther south, a dull green becoming yellow at maturity, sometimes blushed; numerous dots; basin regular, small and russeted; eye small, closed; cavity wide, regular; flesh wavy, yellow, breaking, tender, juicy, with a rich acid flavor; when fully ripe, fine for dessert or cooking; quality good; season in Pennsylvania October to January.

Salome. Origin, Illinois. This variety is but little known in Eastern Pennsylvania. Tree a vigorous, stout grower, does not need as much pruning as some varieties; form a fine round open head, comes into fruiting young and produces enormous crops of fine, perfect fruit. Fruit medium to large, conical, regular; surface smooth; color yellow, almost entirely covered with a pinkish red with occasional stripes; dots numerous, large, distinct, white; basin medium, regular; eye medium, closed; cavity acute, deep, flaring; stem slender, long; core large; flesh rich yellow, breaking, juicy; flavor acid; quality good; uses cooking and market. Season December to February.

Shackleford. Western apple, highly extolled by some nurserymen as a profitable variety to plant as a filler. I find it a good variety to leave alone. It produces large crops of fruit of good size, but worthless for any purpose.

Smith's Cider. Origin, Bucks County, Pennsylvania. This apple had quite a local reputation and was quite extensively planted as a profitable market variety. The tree is a good grower, rather spreading, comes into bearing very young, and bears alternate years enormous crops. If not thinned it overbears; the wood being brash, the branches break under their enormous loads, the tree becomes deformed and devitalized and is short lived. Fruit medium to large, round, conical and often flat, mostly regular; surface smooth, pale yellow covered with mixed bright red splashed indistinctly with bright carmine; dots distinct, largely light grey; basin shallow, wide, plaited; eye small, closed; cavity acute, regular, brown; seeds numerous; flesh white, breaking, juicy; flavor acid to sub-acid, aromatic, not rich; formerly a very good market fruit, but it has lost all prestige and is now sold frequently under other names; season all winter, not planted as much as formerly. It does well wherever planted.

Stark. Origin, Ohio. In some sections this apple is extensively planted. At the Paragon orchards it has not come up to the standard required to keep its place; the fruit is too dull in color, rendering

it a poor seller, and is subject to rot on the tree. Tree is an extra strong, robust grower, forming a very large spreading head, comes into bearing young, very prolific. Fruit large to very large, oblong, conic, regular, surface rough, greenish-yellow, covered with dull brownish red at the base; basin medium, regular; eye medium; cavity deep, acute, regular; stem long, slender; core medium to large; flesh yellow, not fine grained, moderately juicy; quality good. Use cooking, market. Season January to March. Not valuable commercially.

Stayman Winesap. Origin, Kansas. A seedling of the old winesaps introduced by Dr. Stayman, of Leavenworth, Kansas. This is a variety no fruit raiser can afford to omit from the list, whether for family use or commercially. It adapts itself as far as tried to all climates, all altitudes, all soils and is par excellent everywhere. It possesses more valuable points than any one apple with which I am acquainted. It has never been known to fail giving a crop of fruit, and sells for highest prices on any market. It is strange that an apple possessing so many points of merit should remain obscure for nearly forty years; and even at this late day but few of the nurserymen have it catalogued, and when ordered substitute the old winesap or another apple called Stayman. I have the Stayman winesap fruiting for several years, being the first one to introduce it into Pennsylvania, and I think so much of it that I am every year top working other varieties over to Stayman, and were I to plant another orchard nine-tenths would be planted to this variety. Tree is a very vigorous grower of the winesap habit, bears very young, frequently at three years transplanted; one of the good features of great value it possesses is hanging to the tree until winter, picking never hurries you. Fruit medium to large, oblate, conical, greenish yellow mostly covered and distinctly splashed and mixed with dull dark red; with numerous grey dots; flesh yellow, firm, tender, juicy, mild, sub-acid, aromatic; quality best. Season November until May. I have kept specimens until June without cold storage.

Stuart's Golden. Origin, Ohio. This valuable variety is but little known, and yet it possesses such excellent qualities that it should be in every orchard. Tree is a rapid grower, limbs somewhat slender, top round, open, spreading; early and abundant bearer, indeed it bears too much and needs thinning. Fruit is above medium, globular, oblate, regular, very handsome; surface smooth, golden yellow, with beautiful carmine blush; basin shallow, even; eye small, closed; cavity wide, regular; stem slender, medium long; core small; flesh yellow, tender, breaking, juicy; quality sub-acid, rich; quality best. Uses dessert, market and cooking; season January to May.

Sutton Beauty. Origin, Massachusetts. This variety is highly praised as a valuable market fruit, seems to be especially adapted

to New York State. I believe this fruit would prove valuable in the northern counties of Pennsylvania, as it does well where the Baldwin is at home. Tree is a good grower and bearer. Fruit medium to large, roundish somewhat inclining to conical, waxen yellow, striped with crimson; flesh whitish, crisp, tender, juicy, sub-acid; fine flavored; fruit very handsome, fine keeper. No good south of latitude 41.

Tolman Sweet. Origin, Rhode Island. This variety is a favorite sweet apple in New York State, where it is used as a baking apple, and for feeding stock; but Pennsylvanians prefer other diet to baked apples, and as sweet apples are not much used for dessert, it is not much planted in this State. The tree is very hardy and productive. Fruit medium to large, nearly round, somewhat flattened, regular; surface smooth, yellow; dots small, dark; it has generally five distinct lines running from stem to eye; basin wide, regular, leather cracked; eye small, closed; cavity rather wide, regular; stem medium size, long; core heart shaped, regular; seeds numerous; flesh yellow, breaking firm; flavor very sweet; quality good; season December and January.

Wagoner. Penn Yan, New York. Tree a good grower, but does not attain a very large size; rather upright, forming a round open head; fruit large, oblate or globular-oblate, a remarkable early bearer and enormously productive; so much so that if not thinned while young the tree becomes dwarfed and the fruit gnarly and small; surface smooth, well covered with mixed bright red, stripes not distinct; dots scattered; basin wide, abrupt, regular; eye small, closed; cavity wide, regular, brown; stem medium, green; core regular; flesh yellowish white, tender, fine grained, juicy; flavor mild sub-acid; quality good; uses market, dessert and kitchen; season November and December. This variety drops too badly for the southern portion of the State.

Westfield Seek-no-further. Origin, Connecticut. A favorite apple in New York and the Eastern states, and is well thought of as a dessert fruit wherever tried in Pennsylvania. It loses some of its fine qualities by bringing it farther south, although as far south as Berks County, Pennsylvania, it is very fine in quality, but trees do not attain as large size nor do they produce as much fruit. Fruit small to medium, roundish conic; surface smooth in the north; in southern Pennsylvania skin rough, dull red, mixed and striped on yellow often entire fruit somewhat russeted; dots scattered, large, yellow; leather cracked and russeted about apex; basin shallow, regular, brown; stem medium to long; core medium; flesh yellowish white. tender, breaking; flavor very mild sub-acid, aromatic; quality good; use dessert and market; season early winter.

Winesap. Origin, New Jersey. This fruit possesses such a combination of excellent qualities that it has become a general favorite in all the large markets; for cider it has few equals, for dessert it stands among the best, for keeping it is justly esteemed, and for bearing it has few equals. These good qualities formerly placed it at the top notch; but it has some weak points, such as being often undersize, often badly affected with scab, very apt to wilt, etc. It is now being superseded by Stayman Winesap, which possesses all its good points and none of its weak ones. Fruit small to medium in size, oblong, conic; skin smooth with a fine, dark red color, with a few streaks and a little yellow ground appearing on the shady side; flesh yellow, firm, crisp, with a rich high flavor; basin narrow, shallow, plaited; eye small, closed; cavity wide, reddish brown; stem medium; season January to March.

York Imperial. Origin, York County, Pennsylvania. There is no apple on the list that has gained more rapidly in popularity than the York Imperial. It has been steadily forging to the front until it is now one of the leading export apples, bringing prices almost equal to the famous Newton and Albemarle Pippin. This popular apple is through portions of Pennsylvania what the Ben Davis is to the southwest or the Baldwin to New York. Thousands of trees of this variety are being planted annually for commercial purposes. In Adams county around Bendersville, Floradale and Gettysburg large orchards are being planted to this one variety. This section is becoming noted for producing this apple to the highest state of perfection and buyers from distant parts come and purchase the fruit in the orchard. At the Paragon Fruit Farm we have planted quite largely, and our young trees are producing so heavily that we have to thin the fruit on the trees. The tree is a very strong, vigorous grower, forming a very large spreading top. This variety requires more inside pruning than most others. It comes early into bearing, producing enormous crops. At the Sunnside Fruit Farm thirty-five bushels of fine fruit was picked from one sixteen-year-old tree. Fruit is above medium in size, oval, angular; skin greenish-yellow, nearly and sometimes entirely covered with bright red; flesh crisp, tender and juicy, aromatic, retains its flavor and keeps well with or without cold storage; season all winter.

I have given those varieties which I consider most worthy of planting in Pennsylvania, many of which are adapted to the northern section of the State, others to the southern portion. The planters living north of latitude 41 have the advantage in having a larger number of varieties to select from. As nearly all the varieties doing well in the southern portion of the State, excepting a few more tender varieties, will also do well and mature fruit that will keep longer than the fruit produced in the south, while such varieties that are

best in the northern counties become fall fruit by bringing them southward.

I sent a paper of inquiries to planters in every county in the State inquiring as to the best summer, fall and winter varieties. I shall here give results, showing which varieties received the highest number of votes. I will give them in rotation according to votes received:

Early Apples.—Red Astrachan recieved nearly double the votes of any other. Early Harvest came in second; Yellow Transparent and Sweet Primate came third; Sweet Bough fourth; Oldenburg and Summer Rambo fifth. Several other varieties received one or two votes.

Autumn Apples.—Smokehouse and Maiden's Blush come in with a tie at the head of the list; Summer Rambo comes in second; Fall Pippin and Twenty Ounce comes third; Gravenstein, Wealthy and Fameuse come in fourth; Hubbardston, Jeffries, Ewalt, Summer Green come next; several other varieties receive one or two votes. I note that several southern and southeastern counties report Rhode Island Greening, Northern Spy and Baldwin amongst the fall varieties.

Winter Apples.—Baldwin takes the lead, closely followed by Northern Spy, then Greening; next comes Fallawater or Pound; then comes Grimes Golden, York Imperial and King. Winesap, Smith's Cider, Russet, Krauser, York Stripe and Ben Davis come with a tie.

Several other varieties have one or two votes. Warren Co. alone reports favorably on the Newtown Pippin; where this variety can be raised it is profitable. I am pleased to see that planters are placing Ben Davis in the place it belongs, as shown by its receiving but two votes.

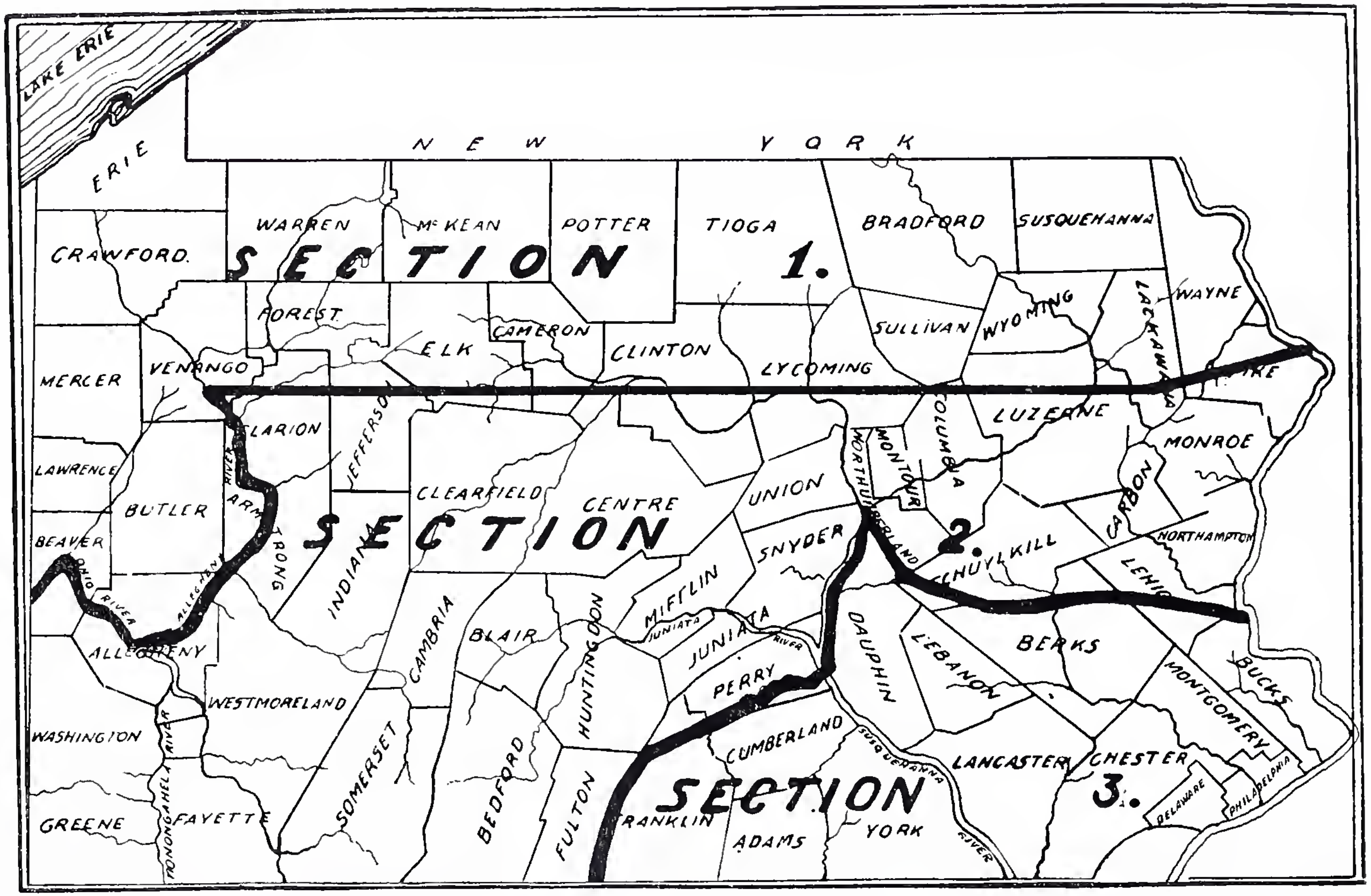
In answer to the question, which is the most profitable winter apple? Baldwin takes the lead, then the Spy; York Imperial and Fallawater come next.

The next inquiry, Do these varieties drop early? The answer is, with one exception, Yes.

In answer to the query, Do they keep well? Over three-fourths of the answers are, No.

What do these answers signify? That there are few good winter apples planted in the state. What constitutes a winter apple? First, one that matures perfectly on the tree; second, one in which the stem is attached firmly to the twig; that it remains hanging until picked; third, that it keeps until late in the season, retaining its flavor without cold storage.

Why have so many planted such varieties that are not giving satisfaction? Custom. The Baldwin has been so long recognized as the standard market apple that people planted it, being un-


LAKE ERIE
NEW YORK
ERIE
CRAWFORD.
WARREN
McKEAN
POTTER
TIOGA
BRADFORD
SUSQUEHANNA
WAYNE
SECTION 1.
FOREST
ELK
CAMERON
CLINTON
LYCOMING
SULLIVAN
WYOMING
LACKAWANNA
MERCER
VENANGO
CLARION
JEFFERSON
LUZERNE
MONROE
COLUMBIA
MONTOUR
NORTHUMBERLAND
LAWRENCE
BUTLER
BEAVER
ARMSTRONG
CLEARFIELD
CENTRE
UNION
CARBON
NORTHAMPTON
SECTION 2.
SCHUYLKILL
LEHIGH
SNYDER
INDIANA
MIFFLIN
JUNIATA
OHIO RIVER
ALLEGHENY
CAMBRIA
BLAIR
HUNTINGDON
DAUPHIN
LEBANON
BERKS
MONTGOMERY
BUCKS
PERRY
WESTMORELAND
WASHINGTON
SOMERSET
BEDFORD
CUMBERLAND
SUSQUEHANNA RIVER
LANCASTER
CHESTER
FULTON
FRANKLIN
ADAMS
YORK
SECTION 3.
DELAWARE
PHILADELPHIA
GREENE
MONONGAHELA RIVER
FAYETTE

familiar with the varieties adapted to their region. But the planters are becoming aware of the fact that it is a mistake to plant these varieties, and inquiries are being made as to varieties that should be planted, and it is the intention to give the best varieties for the different localities and to place it in such a form that it may be more easily understood by the average farmer. I have divided the state into three sections, as can be seen by referring to the map. The divisions are outlined with red. As the topography of the state varies there will be some exceptions; for instance—the Baldwin apple is a true winter apple north of latitude 42, it is a true winter apple in section No. 1 shown in map, where the altitude is over five hundred feet. It is a second grade winter apple in portions of sections one and two where the altitude is from six hundred to one thousand feet. That this is correct, is shown by reports received from the different counties; the Baldwin received the highest number of votes as the best winter apple, yet these same reports say that it drops early, that it does not keep well; we cannot, therefore, class it as a true winter apple, but if the altitude is high enough and the soil a clay loam with clay subsoil, it will acquire the good qualities it does in New York State. I mention the soil because this is always an important factor in profitable orcharding; for instance, the Grimes' Golden, which is one of the most profitable varieties in section three, will produce fifty per cent. more fine fruit in a clay loam than it will in a lighter soil and will keep longer. Keeping in mind these points; soil, altitude, latitude, then referring to the map, and list of varieties given, the planter cannot err in selection of varieties.

SECTION 1.

Including Wayne, Susquehanna, Lackawanna, northern portion of Pike and Luzerne, Wyoming, Sullivan, Bradford, Tioga, Lycoming, northern portion of Clinton, Potter, McKean, Cameron, Elk, northern portion of Jefferson and Clarion, Forest, Warren, Erie, Crawford, Venango, Mercer, Lawrence, Butler and a portion of Armstrong, Allegheny and Beaver counties. Varieties adapted to Section I.—Summer Varieties,—Benoni, Sweet Bough, Early Strawberry, Early Harvest, Red Astrachan, Fanny, Golden Sweet, Yellow Transparent, Primate Sweet. Autumn Varieties.—Jeffries, Summer Rambo, Porter, Stump, Maiden's Blush, Wealthy, Gravenstein, Oldenburg, Twenty Ounce, Wolf River, Paradise Sweet. Winter Varieties.—Stayman Winesap, Grimes' Golden, Jonathan, Baldwin, King, Northern Spy, Hubbardston, R. I. Greening, Roxbury Russet, Stark, Stuart's Golden, Sutton Beauty, Aikin, Dominie, Perewaukee, McIntosh, Tollman's Sweet, Wagoner, Westfield Seek-no-further. Varieties to test.—Rome Beauty, Paragon, York Imperial. Varieties

to plant commercially,—Yellow Transparent, Red Astrachan, Jeffries, Maiden's Blush, Summer Rambo, Wealthy, Hubbardston, Grimes' Golden, Stayman Winesap, Baldwin, King, Northern Spy, Stark, Jonathan.

SECTION II.

Summer.—Benoni, Early Strawberry, Early Transparent, Red Astrachan, Early Harvest, Fanny, Golden Sweet, Primate Sweet. Autumn,—Jeffries, Maiden's Blush, Smokehouse, Summer Rambo, Porter, Fall Pippin, Mother, Wealthy. Winter,—Hubbardston, Stayman Winesap, York Imperial, Rome Beauty, Mammoth Black Twig, Roxbury Russet, Grimes' Golden, Stuart's Golden, Fallawater, Jonathan, Gano, Smith's Cider, Stark, Salome, Dominie. Varieties to plant commercially.—For summer and autumn the same as Section I. Winter—Hubbardston, Stayman Winsap, Grime's Golden, Rome Beauty, Jonathan, Mammoth Black Twig, York Imperial, Fallawater.

SECTION III.

Summer varieties, same as in Section II., with the addition of Summer Queen, Townsend and William's Favorite. Autumn.—Cornell's Fancy, Jeffries, Jersey Sweet, Maiden's Blush, Mother, Porter, Summer Rambo, Senator, Smokehouse, Wealthy, Hubbardston. Winter.—Stayman Winesap, Grime's Golden, York Imperial, York Stripe, Smith's Cider, Stuart's Golden, Salome, Nottingham Brown, Heigis, Highfill, Rome Beauty, Gilbert, Fallawater, Gano, Collins, Ben Davis, Evening Party, Nero, Mammoth Black Twig. For commercial orchards.—Yellow Transparent, Red Astrachan, William's Favorite, Jeffries, Maiden's Blush, Smokehouse, Hubbardston, Wealthy, Summer Rambo. Winter.—Stayman Winesap, Grime's Golden, York Imperial, Nottingham Brown, Fallawater, Gano, Rome Beauty.

Before leaving this subject, I wish to say, there are varieties here listed that are not my favorites, but tastes differ, and the final selection of varieties must be made by each individual grower after extensive research and consultation, concerning the merits of the various kinds in your vicinity. The fact cannot be too strongly emphasized that the principal failure of apple culture is due, primarily, to a selection of kinds not adapted to the location; so in the present and future there is no aspect of apple growing that should be given more serious thought than the selection of permanent varieties. The list represents those varieties that are being planted most extensively. Plant such varieties as are recommended for commercial orchards; do well your part in other respects, and success will crown your efforts.

ENEMIES TO THE APPLE.

Space will not permit us to take up all the insect foes and fungus diseases and treat them scientifically and practically, but as this is to be a handbook for the orchard, we will euumerate and describe such vermin, insects, and fungi, as are met with iu the orchards of Pennsylvania, in as brief and intelligible manner as possible.

A knowledge of these foes and how to control them is essential to successful orcharding, and to acquire this knowledge takes study, not only of books, where the life history is given, but if you would become familiar, and be able to grasp the elements of the classification of the different insects, it will become necessary to investigate this broad field of study for yourselves, by going into the field and the orchard, to use your eyes, and to observe for yourselves.

It is a labor of time, and requires cousiderable effort. Much valuable information can be obtained from scientific works, from the various bulletins issued by the different states; these are great aids. We derive the benefit from the study of these great minds, but when these facts are confirmed by personal observation, and rendered useful and applicable in practice, then we are iu a position to distinguish our enemies from our friends. To destroy the former, and protect the latter, we are prone to jump to conclusions, and in our zeal we frequently destroy our friends, while they are aiding us, by destroying the eggs and larvae of our enemies. Our friends we see, because they are performing their friendly labor by the light of day; many of our worst foes we do not observe, because their work of depredation is committed under the cover of darkness, and we, then, in our ignorance, imagine our fruit and trees are being destroyed by these useful insects.

BORERS (Saperda Candida).

Thousands of apple trees of all ages are destroyed annually by this insect; its work not being discovered until it has so severely injured the tree that it cannot recover. This is commonly called the round-headed borer. The mature beetle is about three fourths of an inch in length, of a brown color, with two plain white stripes lengthwise on its back. The beetle comes in June, and deposits eggs on the bark near the ground. The worm which hatches, soon eats its way through the bark, where it feeds through the first year. If several are in the same tree they never infringe on each others rights, always leaviug a narrow strip of bark between. As their jaws become stronger they attack the harder wood, eating inward and upward toward the heart, making a cylindrical hole three or four inches in length, when it again eats outward until the bark is reached. It then recedes, packing the upper end of the hole tight with fine

chips and worm dust, making for itself a nest with short fibres of wood, forming an elastic bed where it remains during its pupa state. These operations being over, it sheds its larva skin and becomes a pupa, at the close of the second summer. It lies in this state through the winter; in the spring, as warm weather approaches, and the season is far enough advanced, it wakens from its lethargic sleep, pulls down the loose chips that close the upper end of its burrow, until it reaches the bark; through this it cuts a smooth round hole and crawls out of the tree. The sexes then pair, and the female deposits another crop of eggs. Thus it requires three years for this insect to pass through the different stages from the egg to maturity. There is no sovereign remedy for this insect, although several have been recommended, such as painting the trunk with various preparations of soaps, sulphur, decoctions of tobacco, carbolic, etc., but the only sure way to destroy it is, when upon close scrutiny, you observe the saw-dust like material coming from the bark, you open with a pointed knife, cut the bark away over the channel until you uncover the larvae, or insert some flexible instrument, as a piece of annealed wire, or a thin twig, and punch it to death. Trees should be examined several times through the summer and the larvae destroyed before they have injured the tree seriously.

FLAT-HEADED BORER.

This is also a pest that destroys many trees; more liable to infest trees that are on the decline, or where the limbs have sunscalded. It is much smaller than the round headed borer, the adult is a dull metallic color. It lays its eggs upon the bark of the trunk or larger branches. The grub enters the sap wood where it remains two years. Removing the worms and giving the tree good treatment, to restore vitality, are the best remedies. The wood-pecker family are their natural enemies.

APPLE-ROOT PLANT LOUSE.

This is among the worst enemies of the apple. It occurs in two forms. Throughout the summer it can be seen on the lower portion of the trunk and particularly on the water sprouts, in small cottony patches. It is commonly known as Woolly Aphis, when found on the trees above ground. The other form inhabits the roots and cannot be well seen. It is in this form that it does the most damage. On the roots its attacks cause enlargements or galls or swellings. The injury is due to the sucking up of the vital plant juices, and to the poisoning of the parts attacked, as indicated by the consequent abnormal growths. The damage is especially serious in nursery stock; in larger trees the injury is less marked. A badly attacked tree assumes a sickly appearance and does not make satis-

factory growth and the leaves become dull and yellow; and if the tree is not killed outright it is so weakened that it is subject to borers and other insects, and fungus diseases. This insect infests the apple principally. Some varieties are comparatively immune, such as the Northern Spy. The character of the soil also exerts some influence. Loose dry soils are specially favorable and wet, compact ones unfavorable. The common form both on roots and above ground are wingless lice, not exceeding one-tenth of an inch in length and of a reddish brown color, and abundantly covered, when above ground, by a flucculent waxy excretion. These are so-called agamic females, and reproduce themselves by giving birth indefinitely for years without the intervention of other forms. The newly born larvae have none of the white excretion, which however soon appears as a minute down when they begin to feed. These lice differ from most aphides in not having the honey tubes, but exude the honey dew from the tips of their bodies. Late in the fall, October or November, numbers of winged individuals appear, which are all female, and are the parents of a true sexed generation of minute wingless larvae-form lice, the females of which, as in the case of the grape-root louse, give birth to a single egg, "winter egg." This egg is attached within a crevice of the bark, and hatches in the spring into a female aphid, which originates a new aerial colony. It is by means of the winged females they spread locally, but to greater distances by nursery stock.

Remedies and Preventives.—Those above ground are easily destroyed by any of the washes used for destroying plant lice, such as kerosene emulsion, whale oil soap, the resin soaps or tobacco; this must be applied with sufficient force to penetrate the covering and protecting cottony excretion, if applied warm its penetration will be considerably increased. The root form is more difficult to exterminate; the simplest remedy is to remove the soil from off the roots near the trunk and bury tobacco dust over them. Lime and gas-lime are also recommended when the roots are uncovered; hot water not quite boiling poured over them is a sure remedy and inexpensive. Tobacco dust used freely around trunks covering the ground is the best preventive. Fumigation of nursery stock destroys the insect in every form. It also has a number of natural enemies, among the most common is the lady-bird.

OYSTER SHELL BARK LOUSE.

This insect is very destructive, and when a tree becomes badly infested it cannot long survive. It was introduced from Europe more than eighty years ago. It appears in the form of minute scales, about one-sixth of an inch long, of a brownish or grayish color, closely resembling that of the bark of the tree, and closely

resembling an oyster shell in shape, adhering to the surface of the bark, most of them lengthwise with the limb, with the smaller end upwards, and often entirely covering the bark. Under each of these scales will be found from fifteen to fifty or more eggs; during the winter these are white in color, but before hatching they become a yellow tint, when the insects soon appear. This is toward the latter end of May or beginning of June. If the weather is severe the young lice remain often several days before they disperse over the tree, during this time the entire surface appears to be one moving mass, as they run over the twigs seeking a suitable place to which to attach themselves. The young lice are extremely small, about one-hundredth of an inch in length. In a short time the majority of them become fixed around the base or side of the shoots of the terminal twigs, where inserting their small sharp beaks, they subsist upon the sap of the tree; in a very few days delicate waxy threads issue from their bodies, forming a protection; as the louse grows the secretion continues; before the end of the season it is completely covered by a scaly covering in which it lives and matures; but its life as a louse is not long, for by the latter end of August the female has become a bag of eggs, and the process of depositing them now begins, the body of the parent gradually shrinking day by day, until there is nothing left but the mass of eggs with a small remnant of the louse at the small end of the scale.

The scales of the male are smaller, and are found more generally upon the leaves. There is but one brood in a season in Pennsylvania and farther north. It is disseminated principally on nursery stock, on the feet of birds, and large insects. Their preference is the apple, but are often found on the pear and plum, while the lilac and ash are frequently killed by them. Remedies.—They have many natural enemies, the most valuable ones are the lady-birds. The larvae of the twice stabbed lady-bird, (this variety is easily distinguished by its highly polished black wings with a bright red spot on each) an active little creature of a grayish color, devours large numbers of them. The adult beetle also eats them, as well as many of our small insect eating birds. Where trees are sprayed with lime, sulphur and salt, they are destroyed.

SCURFY SCALE.

This insect is supposed to be a native of America, and originally found on the bark of our native crab trees. It is much more common in the south than farther north. It is readily distinguished from the oyster shell louse; the scale of the female, which are the more numerous, being oblong in form, pointed below, very flat, of a grayish white color, about one-tenth of an inch long. The eggs under the scale are a purplish red; they hatch about the same time,—latter

end of May, earlier farther south. It does not mature so rapidly as the oyster shell louse, the eggs not being fully developed until the middle of September. The scale of the male is very much smaller than the female, not more than one-thirtieth of an inch long. It affects the apple, pear, mountain ash, and even the wild cherry. In Eastern Pennsylvania it is more common, but farther north not nearly as much so, as the oyster shell louse, and nowhere anything like as injurious. The treatment is the same as for the former.

SAN JOSÉ SCALE LOUSE.

There are several varieties of lice, protected by scales, that are very injurious to our fruit and deciduous trees; but of the all, there are none so minute, so prolific, yet so deadly in their effect, as the San José Scale. They are indeed so inconspicuous that thousands of farmers and fruit raisers do not know they have them, until their orchards are injured almost beyond recovery, Only two or three years ago, I made it a point to ask the question at Farmer's Institutes if they had this pest, and the answer, with few exceptions, was, No. Now I can step aboard the trolley at Boyertown, go through the beautiful Oley Valley, to Reading; from there through the fertile Lebanon Valley to Harrisburg; thence through Cumberland and Franklin Counties to the Maryland line; or I can travel North, South or East, and what do I see? Thousands of trees dead, and thousands more dying. In many orchards, and whole villages nearly every tree is beyond redemption. What does this show us? That in this small insect, we have a foe so subtle that it can work beneath the very eyes of the ordinary man without detection; while they felt secure it was committing its deadly work, and strange as it may seem, after all these years, when every newspaper throughout the country has printed article upon article; lectures have been delivered by the hundreds at Farmer's Institutes and Horticultural meetings, describing this insect, yet hundreds of farmers know absolutely nothing about it; their trees are dying, limbs encrusted, fruit so marked, you can scarce tell its true color. Ask them what is the matter and they tell you they do not know. If this continues what will be the fruit prospects in a few years? The man with ten acres of well cared for orchard will have an independent living.

The history of this insect has been so often given, that anything farther in regard to its origin will be unnecessary; but a short description may not be amiss. If examined in winter, trees badly infected, the limbs appear to be covered with ashes and a little soot; upon closer inspection we find this is made up of small circular scales, about one-sixteenth of an inch in diameter, rising in the centre in the form of a nipple with a slight indention on the top. In color they vary from a light dirty gray to almost black. If these

scales are raised with any pointed instrument a small jelly like body, yellow in color, without eyes, wings, or legs, is found beneath. If left undisturbed, they remain in this condition until about June 10th, in the southern portion of the State, later farther north, when they give birth to living young. A single female may give birth to about four hundred young, or ten a day for forty days, and when these are one month old, they in turn, bring forth a new generation. In latitude 40 I have seen five generations in one season; so the progeny of one female may, in the most favorable seasons, count up to billions. When the young are born, they are minute, yellow, almost microscopic insects, with six legs, two antennae, and a proboscis. For eighteen to forty-eight hours they roam about, seeking a suitable place to attach themselves; when fixed, a waxy thread-like exudation comes from their bodies, and soon forms a complete covering, under which they come to maturity.

If they are not numerous, they are often difficult to see, especially to the unpracticed eye; they can generally be found around the base of the buds, a favorite place is among the rings that separate the present year's growth from last season's. When in doubt as to their identity, shave off the bark beneath the scale, and you will find red streaks, formed by the poison injected by the insect; this red penetrates the cambium and often into the wood itself. The fruit also becomes covered with red spots. Can they be controlled? Certainly they can. I have had trees at the Paragon Fruit Farm so badly infested that the fruit was so completely covered and marked as to be unsalable. The terminals were killed back a foot or more, all limbs and trunks were thickly incrusted, bark, cambium and sap wood was red. The trees were condemned as incurable. But not wishing to lose them, they were thoroughly sprayed. The trees were saved without the loss of one crop, and are to-day in perfect health and free from scale.

Remedies.—The safest and surest is the boiled lime, sulphur and salt, properly made and thoroughly applied while the tree is dormant, any time when weather permits, from the time the foliage drops in the fall until the buds begin to expand in the spring. This holds good for apple and pear, but go slow on spraying peach in the fall, and leave the salt out. It proves just as effectual without as with the salt. Many peach trees were seriously injured both buds and young terminal shoots that were sprayed in the fall of 1905. There has been considerable dissatisfaction in the use of this preparation, but the fault was not in the remedy, but with the user, for it has never been known to fail when properly made and applied. Whale oil soap has been used with good effect, but it often destroys the buds. The different oils, crude petroleum, kerosene, soluble oils, etc. These preparations and how to prepare and apply them will

be given in detail under the head of Insecticides, Fungicides and Spraying. If old trees are too far gone, the better plan would be to cut them down and burn the twigs. If a large tree is still in good condition, prune out all unnecessary branches, cut back the top, then spray with one of the prescribed remedies.

THE SEVENTEEN YEAR LOCUST.

This insect is so well known that a description is unnecessary. It injures the trees by puncturing and sawing slits into them in which they deposit their eggs. Young trees and limbs are frequently so cut into that the rough winds break them off. There are two remedies that are effective; the one is a preventive by binding the trunks of the trees from the ground up to and even among the limbs, using rye straw or matting, keeping them covered from early May until the middle of July, by which time the insects have performed their mission of laying eggs, and have died. The other is to keep up such a thrifty growth by fertilization and culture, that the wound grows shut before injury is done. My peach orchard that has made such a record was planted in the spring of 1902, the year for locusts in Berks County, Pennsylvania. The orchard was swarming with them, many of the trees were punctured and had eggs deposited very closely together from the bottom to the top, but we kept the trees growing so rapidly that the wounds healed enclosing the eggs, and I am satisfied the young, if they hatched, never got out. Not one tree was injured, so I would not hesitate planting an orchard in the spring of the locust year. The natural enemies, birds, chickens, hogs, and predaceous insects feed upon them, devouring large quantities.

FIELD MICE.

The short-tail field mouse often destroys a great many trees. They become very troublesome where much trash is left on the ground. Clover sod makes a good harbor for them. In earlier times, before we were experienced, we lost some valuable young trees; but for several years we have kept them off by a very simple device. In early autumn clean all trash away from around the tree, at least two feet on every side, then make a small hillock about six or eight inches high around each tree, packing it firmly. We have never had a tree injured since adopting this plan. They may also be poisoned by dropping corn or wheat soaked in a strychnine solution, in their runways, but you run great risk of poisoning some of the friendly birds. Another remedy, but one too liable to be neglected, is to clean as above, then after each snow over two inches in depth, to go through the orchard and tramp it down firmly around each tree.

RABBITS.

These little animals, when plentiful or food is scarce, as when the ground is covered with several inches of snow, often become very destructive, barking the young trees from the ground to as high as they can reach. The best remedies are to trap or shoot them; or they may be poisoned by putting poisoned apples at different parts of the orchard; or they may be kept off by banding the trunk, or by smearing the trunk with blood, or some poisonous wash. The rabbit is a very clean animal, a dainty feeder, and he will not touch anything that is unclean.

SHOTHOLE BEETLE.

This is a very small insect, about one-tenth of an inch long; it is cylindrical in form, of a dark chestnut brown or black, its legs and antennae are pale yellowish. It bores under the bark, it is more liable to attack trees that lack thrift; they tunnel beneath the bark until it becomes loosened from the wood, and the leaves and young wood look as though scorched by fire. Soon after, the small beetles appear, crawling through minute perforations in the bark like large pin holes. This insect usually appears in July, if plentiful it is sure to kill the tree. The only remedy is to cut off the affected limb (or the entire tree if the case is serious) and burn.

APPLE TREE PRUNER.

This insect is not found in sufficient numbers in Pennsylvania orchards to do much injury. It is a long horned beetle of cylindrical form, of a dull brownish color, with brownish wing cases, the entire body is covered with short grayish hairs. This insect affects the oak and the apple tree, and is found throughout the northern portion of the United States. It received its name from its peculiar methods of working. The parent beetle places an egg in the axle of a leaf, on a fresh green twig proceeding from a moderate sized limb. When the young larva hatches it burrows into the centre of the twig and down toward its base, consuming the soft pulpy matter of which this part of the twig is composed. By the time it has reached the larger limb it has become mature enough to feed upon the harder wood, and makes its way into the limb. The larva, being now about half grown, eats a short distance through the middle of the branch, and then gnaws away the woody fibre of the limb to such an extent that the first wind storm breaks off the branch. After the branch has fallen it eats its way slowly through the centre of the limb from six inches to one foot; by this time it has completed its larva stage, and is transformed to a pupa within the enclosure. Sometimes this transformation takes place in autumn, but generally in the spring, and from the pupa the perfect beetle makes its appearance during June.

The average farmer is not a very close student of nature, therefore, not a close observer of things transpiring in everyday life around him. If he sees a limb hanging on his apple tree, suspended by a piece of bark, or sees a stub of limb apparently broken off short, and the branch lying on the ground, he passes it by as some freak of nature. Were he to examine this stub he would find it was not broken but gnawed off; if he picks up the fallen branch and splits it open, he will discover the larvae which is from one-third to one-half inch in length, thickest at the head tapering backward. The head is small and black, the body yellowish white, with darker markings; it has six minute legs attached to the anterior segments, or if in the pupa, it is about the same size of a whitish color. Our friends, the birds, especially those of the wood-pecker family, keep these insects under control; were they at any time to become numerous, they could be easily kept sufficiently reduced in numbers by gathering up the fallen limbs and burning them.

APPLE TWIG BORER.

This is another insect occuring frequently enough to attract attention, yet never in sufficient numbers to seriously injure trees. It is a small beetle about one-third of an inch in length, of a dark chestnut brown color above, black beneath. Unlike most insects which do the most injury while in the larva state it does the injury, while in the perfect form, boring into the branches of apple, pear and cherry trees, just above a bud, and working downward through the pith for one to two or often more inches, causing the twig operated on to wither and their leaves to turn brown; upon examining such a twig, a perforation about the size of a knitting needle will be found near one of the buds about six inches to a foot from the end of the twig; such twigs break off with high winds. Remedy,—Gather the bored twigs during June and July and burn, thus destroying the beetles concealed in them.

TENT CATERPILLAR.

For full description and life history of this insect, the reader is referred to Bulletin 120, published by the Department of Agriculture of Pennsylvania.

This insect infests the orchards of nearly every part of the United States. Some years they become so plentiful that entire trees and entire orchards are defoliated by them and nothing left but bare twigs and their unsightly tents. The moth is of a pale dull reddish brown color, crossed by two oblique parallel whitish lines. In the male the antennae are pectinate or feather-like, and slightly so in the female; when fully expanded, the wings of the female will measure one and one-half inches across; the male is smaller. After pass-

ing from the pupa to a perfect moth, their life is short, as they are incapable of taking any food, not having any hollow tongue or tube, as other moths or butterflies to imbibe food; consequently they live but a few days in the winged state, merely long enough to provide for a future generation by the deposition of eggs.

The eggs are deposited during the month of July upon the smaller twigs of our fruit trees, in ring like clusters, each composed of from fifteen or twenty rows, containing in all about two or three hundred. The eggs are conical, about one-twentieth of an inch long, firmly cemented together, and coated with a tough varnish. The clusters of eggs can be readily seen upon the terminal shoots of the tree. The young caterpillars mature in the egg before winter and remain in a torpid state in this enclosure through the winter, hatching during the first warm days in spring, usually the last days of April or early May, generally about the time the terminal buds are opening. Their first meal is the gummy substance covering the eggs, after which they crawl to the terminal buds feeding upon them; they congregate in the fork of a limb and begin weaving their tent for shelter; from this they emerge daily, generally about nine o'clock mornings, again in the afternoon, returning to their tents toward evening. Before the second moult the first tent is abandoned and a new one constructed on the larger limbs, with several forks; this tent is much larger. The young caterpillar grows by moulting, when its skin gets too tight it bursts open down the back and the young caterpillar creeps out clothed in a new very soft skin; after which it grows very rapidly. It sheds its coat five times during its growth. The inside of the tents become filled with castings and excrement of the insect. The fifth moult occurs after the cocoon is finished and the insect is then in the pupa state. The time between the moults depends upon the weather and the food supply; when the tree upon which they are feeding becomes defoliated they leave it in search for food, when hunger compels them to feed upon almost any kind of leaves, but from choice the wild cherry and the apple take precedence. The adults hatch from the cocoon in about three weeks.

The remedies are simple. The tents being so conspicuous, they can be destroyed by the torch; or by cutting off the smaller limbs with the tent when first formed; or by rubbing between the thumb and finger the latter not being a pleasant method, but when the tent is first started it is a quick method of destroying, without injury to the tree. Many trees are badly injured by the torch used by careless workmen. They can also be destroyed by spraying with some arsenite.

If the orchard is sprayed in the fall or spring while the trees are dormant, using the lime-sulphur wash, there will be no tent caterpillars to destroy, as it kills them all while in the egg. I have never

seen any of the first brood of tent caterpillars in a thoroughly sprayed orchard.

Natural enemies are the birds,—the yellow beaked cuckoo, the golden oriole and others. There are also parasites that destroy this insect, some by depositing their eggs within the egg cluster where the young feed upon the eggs and young caterpillars, others deposit their eggs on or beneath the skin of the caterpillar, which shortly hatch and feed upon its victim, without destroying the vital parts, the caterpillar living to construct its cocoon, but instead of the moth, one or more of these friendly insects make their appearance.

WHITE MARKED TUSSOCK MOTH.

A very beautiful marked caterpillar when mature, more than an inch long, of a bright yellow color, with the head and two small protuberances on the hinder part of the back of a brilliant coral red. Along the back are four cream colored brush-like tufts, two long black plumes on the front part of the body and one on the back part. The sides are clothed with long fine yellow hairs; there is a narrow black or brown stripe along the back, and a wide dusky stripe on either side. There are two broods during the summer, the first completing their larval growth and spinning their cocoons about the middle of July; the second hatching about the last of July, and completing their growth by the end of August; the moth from these latter depositing their eggs, which remain on the trees over winter. The female is wingless, therefore their spread is not rapid. Her body is of light gray color and an oblong oval form, and is distended with eggs; after her escape she waits the attendance of the male, then begins to place her eggs on the outside of the cocoon, fastening them with a frothy gelatinous matter, which makes them adhere together. On walking through the orchard in winter one will frequently find a dead leaf or leaves fastened to the branches of the trees; on examination they will mostly be found to contain a cocoon with a mass of eggs fastened to it. On breaking this mass, which is brittle, it will be found to contain from three to five hundred eggs, about one-twenty-fifth of an inch in diameter, of a white color, nearly globular and flattened on the upper side. About the middle of May these eggs hatch, and the young caterpillars at once begin to eat the leaves of the tree; when disturbed they let themselves down by a silken cord and remain suspended until the danger is past, when they climb up to their former position. Remedies.—Gather the egg clusters in fall or winter, spray with arsenites.

YELLOW-NECKED CATERPILLAR.

The mature moth measures two inches across the expanded wings, of a light brown color, with head and a large spot on the thorax

chestnut brown. The female deposits her eggs in single clusters of from seventy-five to one hundred. They are white, round, less than one-thirtieth of an inch in diameter, placed side by side in nearly straight rows, and firmly cemented together, as well as to the surface of the leaf to which they are attached; those first laid begin to hatch about the third week in July, while others are three or four weeks later. The young larvae eat only the under side and pulpy part of the leaves, leaving the veins and upper side untouched; but as they increase in size they devour the entire leaf except the stem.

When young the larva are brown, striped with white, but as they mature they become darker in color, with yellow stripes; they attain their full growth in about six weeks, when they are about two inches long. The head is large and black; the next segment called the neck is dull orange, a black stripe extending down the back, and three stripes of same color alternately with four yellow stripes on each side. The larva are found clustered together closely on a limb, on which, beginning with the tender leaves they devour all before them, leaving the limb bare, with perhaps a few stems. If alarmed, they throw up their heads and tails, bending their bodies until the two extremities meet. When full grown they nearly all leave the tree at the same time, descending by night to the ground, where they burrow under the surface from two to four inches, and after a time cast their caterpillar skins and become naked brown chrysalids. They remain in the pupa state until the following July, when the moths escape and take wing. This insect is not very plentiful, but this season, 1906, they were more numerous than for many years. Remedies.—They are easily destroyed by cutting off the branch and tramping on them or by spraying.

RED HUMPED CATERPILLAR.

Closely resembling the former in its habits; can be treated the same.

GYPSY MOTH.

This is one of the most dreaded insects of the present time, and should it become as widely spread it will be much more difficult to hold under control than the San José Scale, as it feeds upon all kinds of trees, whether in orchard or forest. The female, as well as the male, has wings, therefore spread more rapidly. As the caterpillars near maturity they feed by night, hiding in any obscure place by day. They seem to be much less susceptible to arsenious and other poisons, requiring greater strength. At present this insect is confined to Massachusetts, Rhode Island, and New Hampshire and a portion of Connecticut. It became so destructive in Massachusetts that the commonwealth took the matter in hand in 1890

and during the next ten years expended $1,000,000 to exterminate it, and so far succeeded that in 1900 but little damage was done; but in 1905 the pest had spread over so much territory, and had become so troublesome that another $300,000 was appropriated to carry on the warfare until May, 1907.

Life History.—The eggs are laid, usually on the trunks and branches of trees, in July and August, in oval masses, each containing about five hundred eggs. The eggs hatch about May 1st, and the young caterpillars soon begin to feed upon the expanding foliage, devouring all kinds of vegetation; all the damage is done in the larva stage, when full grown the caterpillar is between two and three inches long, dark brown, with two rows of red spots and two rows of blue spots along the back, and is covered with long hairs. The caterpillar usually reaches full size in July, and transforms into a pupa, usually spinning a few threads about itself. During the later half of July the adult moths emerge, mate, and the females lay eggs. The male has a wing expanse of one and one-half inches, and flies about in the day time in a zig-zag course. The female has a heavy body and does not fly far, though furnished with wings which expand about two inches, and which are nearly white with delicate black markings. There is but one brood each season.

Means of Distribution.—As the caterpillars crawl about, going from one tree to another, they are apt to invade freight cars on the siding, and be carried to other places. The caterpillars have the habit of spinning down on slender threads from their food trees, and may thus drop on carriages, automobiles, or railroad cars, and be carried long distances into a part of the country heretofore uninfested.

Natural Enemies.—Are not plentiful, but parasites and predaceous insects, birds, toads and other insectivorous animals all aid to a certain extent.

Remedial Measures.—One of the most effective means of controlling the gypsy moth is by destroying the egg masses on the trunks and branches of trees, on fences, stones or wherever they occur. A swab, brush or sponge is dipped in creosote mixture, and the egg masses are saturated with it. A long pole can be used to reach the egg masses. Spraying the foliage with arsenate of lead, using five pounds to fifty gallons of water, will save the trees for the season; Paris green can also be used at the rate of one pound to one hundred gallons of water with two pounds of lime to prevent burning the foliage, but this will not adhere to the leaves as well as arsenate of lead. So far this terrible pest has not reached Pennsylvania, but it is well always to be on the lookout for any new enemy and be prepared to fight it with the best weapons.

FALL WEB WORM.

This detestable hairy enemy makes its appearance after the fruit grower has been congratulating himself on his success in ridding his trees of the tent caterpillar and other like enemies. In the Southern and Middle states it is a double brooded insect, the first making its appearance in June, the second in August. In Pennsylvania we have the most trouble with the second brood. The moth of this species deposits her eggs in broad patches on the under side of the leaves near the end of the branch, during the latter part of May or early June. These hatch in July or August. As soon as the young larva appear they begin to eat, and spin a web over themselves. They devour only the pulpy portions of the leaves, leaving the ribs and stem. While young they are of a pale yellowish color, sparingly hairy, with two rows of black marks along the body. When full grown they are an inch or more in length and vary greatly in their markings; some are pale yellow or greenish, others much darker and of a bluish black hue. The head is black, and there is a broad dusky or blackish stripe down the back; along each side is a yellowish band, spreckled more or less with black. The body is covered with long straight hairs, grouped in tufts, arising from small black or orange yellow protuberances, of which there are a number on each segment. The hairs are sometimes of a dirty white, sometimes a reddish brown; they are longest toward the extremity of the body. The larva do not leave their nests and wander about like the Tent Caterpillar, but extend their web over their entire feeding ground, until often the entire limb is covered with their webs; when a tree is covered with these webs it presents the appearance of being scorched. When nearly mature they abandon their homes and scatter, often becoming very troublesome about the houses, and if one comes in contact with the skin these stiff hairs penetrate and cause irritation and itching that is hard to allay. During September and October these caterpillars descend to the ground and burrow a short distance beneath the surface, or under crevices of the bark, or any sheltered place, where they form cocoons of silk with the hairs from their bodies interwoven. Within these cocoons they change to chrysalids of a dark brown color, in this condition they remain until the following season. The moth is of a milk white color without spots; when wings are expanded they measure about one and one-fourth inches across; the moth flies only at night.

Remedies.—They are easily detected by their webs, in their early stage, and they are easily removed by clipping the small branch and destroying, or by spraying the trees with one of the arsenious poisons.

CANKER WORMS.

In many sections of the country these worms have become so numerous as to seriously injure the trees by denuding them of their foliage. There are two or more distinct species of this insect, but their habits and appearance are so near alike that they can be treated under one heading.

The females of the canker worms are wingless; they lay their eggs side by side in regular masses of one hundred or more; these are placed in exposed situations on the twigs or branches of the tree. They hatch about the time the young leaves of the apple push from the bud, when the little larva cluster upon, and consume the leaves, and should the weather be cold or wet they seek shelter in the bud or bloom. When full grown they measure about one inch in length. They are often known under the name of measure worms or loopers, because they loop their bodies in moving. They have many colors from greenish yellow to dark brown; they are very often hard to detect when not in motion, as they are frequently the color of the twig or leaf, and assume a stiff posture that looks as if they were a part of the tree. When fully mature they descend to the ground and burrow into it to the depth of two to six inches, where they make a tough cocoon of silk interwoven with particles of earth; here they pass to the chrysalis state, where they remain during the summer. The moths make their appearance after the first mild frosts. The female being without wings and sluggish in her movements, with her body distended with eggs, drags her weary way along until she reaches the base of a suitable tree, up which she climbs, and there waits the arrival of the male, after which she proceeds to lay eggs for next season's progeny.

Remedies.—Since the female is incapable of flying, she must ascend the tree by crawling. Now any means of preventing this will be more or less effectual. Cotton bands tied around the trunks, as long as they are kept loose and fluffy prevent her passage; any sticky substance, as fly paper, tar mixed with oil to prevent drying, this spread on paper or cloth and tied around the trunks is also effective; a shield like an inverted funnel makes an impassable barrier; but these must be in place during fall and spring months. Trees that are thoroughly sprayed before blossoms open, and after petals drop, with an arsenite, such as is used for the Codling Moth, will be effectual in completely ridding trees of this pest. There are several natural enemies, among which are the soldier bug, wheel bug, the Potter wasp, etc.

There are many other insects more or less injurious to the leaves of the apple, but are not sufficiently numerous, or injurious to devote space to their description, habits, etc.,—The leaf folder, leaf crumpler, bud moth, the green apple leaf-tyer, the apple leaf-sewer,

the apple-leaf skeletonizer, are none of them troublesome on properly sprayed trees.

Before leaving insects injurious to apple leaves, we must not omit the apple tree aphis. During winter, about the base of the buds and in the crevices and cracks of the bark, may be found a number of black shining eggs, oval in shape. These are the eggs of the apple tree aphis. They are laid in the autumn, and when first deposited are a light yellow or green, but gradually become darker and finally black; they have a very hard shell, not easily destroyed. As soon as the buds begin to expand in the spring, these eggs hatch into small lice, which locate themselves upon the buds and tender twigs and leaves, and inserting their beaks, suck the juices; all the lice hatching at this season are females, and reach maturity in ten or twelve days, when they commence giving birth to living young, producing about two daily for two or three weeks after which the older ones die. The young locate close to the parent; they also mature and become mothers in ten or twelve days. Thus they increase so rapidly, that as fast as new leaves expand, new colonies are ready to occupy them. As the season advances some of the lice acquire wings, and flying to other trees, start new colonies; when cold weather approaches, males as well as females are produced, and the season closes with a stock of eggs deposited for the perpetuation of the species another season. Both the winged and wingless lice are similar in color; the head, thorax and antennae are black; the neck usually green, oval in form, about one-tenth of an inch in length.

Most of these insects are provided with two little tubes, which project, one on either side, from the hinder part of their bodies; these are called honey tubes, from them is secreted a considerable quantity of sweet fluid; this, falling upon the leaves and evaporating, gives them a shiny appearance, as if varnished; this is known as honey dew, and many insects, as well as ants and flies, are very fond of it. Ants stroke the insects with their antennae to induce them to part with some of the sweet liquid, which they greedily sip up.

The leaves of the trees, infested by these insects, become twisted and curled backwards, often with their tips pressing against the twig upon which they grow, and thus form a covering for the aphids, protecting them. Remedies.—Spraying the trees with lime, sulphur, salt, wash (boiled) is most beneficial; this must be done while trees are dormant. Just at the time the buds are bursting, spraying with soap-suds, tobacco water, or weak whale oil soap, destroys the lice. The natural enemies are the large family of lady-birds; these consume them in the mature and in the larva state, the larva being voracious feeders.

INSECTS ATTACKING THE FRUIT.

THE CODLING MOTH.

This insect has caused more loss to fruit raisers than all the other insects combined. Indeed, so common is it throughout the entire country that where orchards are left unsprayed fully 90 per cent. of the fruit is wormy, a large proportion falling to the ground before reaching maturity.

Since the Codling Moth is so well known in most localities and since there is already much in print concerning its life history, an additional description seems hardly necessary; but for the benefit of those who may as yet be unacquainted with it, a few words may not be amiss.

How the Codling Moth Appears in Each of the Four Different Stages of its Life History.

The Adult—Is a small, brownish-gray moth, having a wing expanse of about three-fourths of an inch. Upon close examination the fore wings are found to bear, near the outer margin, a small spot of brown and gold, while the remainder of the surface has more of a mottled aspect; the hind wings are somewhat lighter, not mottled, and are covered with long hairs, which extend beyond the outer margin, forming a fringe; the fore wings also bear a fringe, which is not quite so long.

The Egg—May be described as a very thin sheet of gelatin, faintly yellowed, and smaller than a pin's head; early in the season the majority are found glued to the young fruit, but larger numbers appear on the leaves.

The Larva—When first hatched is rarely seen, it being but little longer than the width of the egg; but when full grown, measures about three-fourths of an inch in length. The head is dark brown, while the body is of a pinkish tint, which gradually fades to an almost pure white on the under side.

The Pupa—Found within the silken cocoon spun by the larva in some sheltered place, such as a crevice, beneath a piece of rubbish, &c., has very much the shape of many of our common cased chrysalis, is about half an inch long, and is of a light brown color.

Some Facts Regarding the Life Cycle of the Insect.

Various writers disagree slightly regarding the time consumed by the moth in passing through the four stages of its life cycle. According to their observations it ranges from 49 to 58 days, during the summer months, when the conditions are most favorable. The over-wintering brood of course takes longer. The early brood of moths appear on the wing about the time of opening of the apple

bloosoms, when the female deposits her tiny yellow eggs, singly, in or near the calyx or eye, just as the young apple is forming; in some instances they are laid on the side or even in the cavity of the stem end. In about a week the egg hatches and the tiny worm begins to eat its way through the apple into the core, generally in the calyx. Usually its castings are pushed out through the hole by which it entered; hence, before the larva is full grown, the infested fruit may be detected by a mass of reddish grown exuvia protruding from the eye. Sometimes, as the larva approaches maturity, it eats a passage through the apple at the side, and out of this opening thrusts its castings, and through it, when full grown, the larva escapes. In three or four weeks from the time of hatching, the early brood of larva attain their full size, when the occupied apples generally fall prematurely to the ground, sometimes with the worm in them, but more commonly after the worm has escaped. The larva, which leave the apple, while still on the tree, either crawl down the branches to the trunk of the tree or let themselves down to the ground by a fine silken cord which they spin at will; after seeking a suitable place, they spin their cocoons, which are very poorly constructed; after the cocoon is completed, the change to the chrysalis takes place; in the early brood in about three days. The insect remains in this condition about two weeks, when the moth escapes. Each moth is capable of laying about fifty eggs; these are laid successively, extending over a period of two or three weeks; add to this fact that some of the moths are retarded in their devlopment in the spring, and it is not difficult to account for the fact that we find larva of the first brood extending over a long time; indeed, we sometimes find larva of the first brood that have not escaped from the fruit before some of the larva of the second brood make their appearance; thus the two broods overlap each other. The moths conceal themselves through the day and fly by night, and are seldom seen.

The second brood of moths are usually on the wing during the latter part of July, when they pair, and in a few days the female begins to deposit her eggs for the late brood of larva, generally selecting the late apples. The larva mature during the autumn and winter months; if they escape before the fruit is gathered, they seek some safe place beneath the rough bark or other sheltered hiding place; but if carried with the fruit to the cellar, they will often be found about the bins in which the fruit is stored; here they spin their cocoons and remain in them till the following spring. Remedies.—One of the methods of reducing their number is to trap the larva and chrysalis and destroy them; this is done by applying bands around the trees about six inches in width, made of strips of bagging, carpet or any kind of fabric, even common brown paper;

this is wrapped entirely around the tree and tied or tacked. Within this enclosure the larva hide to transform. The bands should be applied not later than the first of June, and should be examined once a week until the last of August; each time the bands are examined all the insects should be destroyed. Many claim the best method is to pick up all the fallen fruit and destroy it, but experience has shown that this is of little avail, as the larger proportion of the larva escape before the fruit falls. The only successful remedy is spraying with some arsenical poisons; but it must be done thoroughly and at the proper time. Many failures are owing to the work being done too late. To be effective, the spraying should be done within a few days after the bloom drops and before the calyx closes, when a portion of the poison will be enclosed; when the young larva begins eating, it gets sufficient of this poison to destroy it. Several applications should be made, as it has been shown that the young larva are being hatched during a long time and one application is not enough.

Paris green may be used, one pound to two hundred gallons of water, to which four pounds of lime has been added, to neutralize the arsenious acid and prevent it from burning the foliage; or better, added to the same quantity of Bordeaux mixture, this will destroy the codling moth, and the Bordeaux, being a fungicide, will prevent scab and other fungus diseases. Owing to the adulteration in Paris green, we have for many years used the arsenite of soda. Arsenate of lead is preferable to either, as it adheres to the foliage much longer and will not scorch the most delicate foliage. Experience has also taught us that care must be taken to have the Bordeaux of the proper strength, for if too strong, in wet seasons, it interferes with the proper development of the fruit, causing rust spots to appear on many varieties of apples and pears. Bordeaux No. 2 should be used.

APPLE CURCULIO.

Every one is familiar with the plum curculio, but many do not know there is an apple curculio. This insect is somewhat smaller than the plum curculio, and differs from it in other respects, its long beak sticks out horizontally and cannot be folded under the body, as can that of the plum curculio; its color and form also differ.

It is furnished with four prominent brownish humps, toward the hinder part of the body; including its snout its length is a quarter of an inch or more; its body is a dull brown, shaded with rusty red; the thorax and anterior third of the wing covers are grayish. It is a native of America, single brooded, and passes its winter in the

beetle state. It appears quite early in spring and the larva often hatch before the middle of June. The time from hatching the egg to the full development of the larva is from nineteen to twenty-one days, approximately twenty days. The period occupied in the pupa state is approximately seven days. Accurate determinations of the full period from deposition of the egg to emergence of the adult beetle form were recorded for three hundred and thirty-five individuals, and range from twenty-seven days as the minimum to the maximum of forty-eight days. The largest number emerged on the thirty-first day.

The main facts of the life history of the apple curculio are well established. Oviposition begins in the spring while the fruits are quite small; the larva feed on the pulp, pupate in the cavity, excavated and emerge from the fruit as perfect beetles. This new generation of beetles hide away for the most part in secure places until late fall, then hibernates until time for oviposition in spring.

Oviposition.—The beetle, with its long snout, drills holes in the young apples, much like the puncture of a hot needle, the hole being round, surrounded by a blackish margin; those drilled by the insect in feeding are about one-tenth of an inch deep and scooped out broadly at the bottom; those which the female makes for her eggs are scooped out still more broadly, and the egg is placed at the bottom. The egg is of yellowish color, long oval in shape, about one-twenty-fifth of an inch in length and not quite half as thick; when the egg is laid it is sealed shut. As soon as the larva hatches it burrows to the heart of the young fruit and feeds upon the core, but in large fruit it feeds upon the pulp. Fruit infested with curculio does not usually fall to the ground as does fruit affected by codling moth. The insect is hard to destroy, as it lives within the fruit during all its stages, but fortunately it is not very plentiful in the Middle and Northern states. The only method would be the same as with the plum curculio, jarring the trees violently during the time when the bettle is about.

APPLE MAGGOT.

This is a fly smaller than a house fly and recognized by its black color, yellow head and legs and white bands across its abdomen. The flies appear early in June, bore holes in the apples and lay their eggs. The eggs hatch within a few days and the larva feed on the pulp of the fruit, which they completely honeycomb; when the larva become full grown they leave the apple and burrow in the ground, where they undergo transformation, in which condition they remain until the middle of the following summer.

FUNGUS DIESASES AFFECTING THE APPLE TREE.

BLIGHT, THE APPLE TWIG BLIGHT.

The twigs of apple trees together with their leaves, flowers and fruit which they bear, often turn brown or black and die, in a manner similar to that of pear twigs affected with pear blight (some varieties, such as York Imperial, Rome Beauty, &c., are very susceptible); such injuries to the apple are commonly called "twig blight" or "fire blight." They are due to the same germs as the pear blight. In former years there were many theories as to the cause and cure of disease; but the investigations of Professors Burril and Arthur show that it is due to the presence of specific germs—one of the bacteria—so minute as to require the aid of a microscope to see it.

It is easily distinguished from other diseases. Limbs affected by it become dead and blackened, together with the leaves, or fruit which they bear. The injury may be confined to one or a few limbs, or it may extend to the entire tree. The germs are so minute that they are carried through the air by the slightest wind. They seem to be unable to penetrate healthy bark, but gain access to the interior of the tree through the blossoms. They light upon the sticky surface of the inside of the flower cup, and are able to begin developing there, passing down through the stem to the twig below. The germ can also gain access through the tips of the growing branches, where the green growth is soft and succulent; they may also enter through wounds or cracks in the bark. After the bacteria has gained access to the interior of the tree they multiply rapidly and generally in the course of a few weeks have become so abundant as to show their presence by blackening the bark or blossoms; as the disease progresses, in serious cases, the germs exude to the surface, and the gummy substance washes off; the gum is dissolved and the germs, set free, are washed into the ground; should this be composed of rich mould they multiply and grow all winter, or year after year. In a dry time the wind takes up the germs into the air, or they may be taken up by simple evaporation. Now, when the surface of the tissues is tender and moist, as in spring, the air, laden with these germs, playing over the trees, brings the germs in contact with the delicate tissues. The germs are held there by the moisture and enabled to grow; the disease gets a foothold, and in a few weeks shows itself by the sudden blackening of the leaves.

Treatment.—So far no application of any spraying mixture has been successful when the disease has gained a foothold; but it is a matter for future experiment, whether a tree, thoroughly covered with such a powerful fungicide as lime, sulphur and salt, will not act as a deterrent, likewise destroy all germs on the tree. And as

the ground becomes completely covered with the material, which will be washed down in the soil, destroy all germs with which it comes in contact. The only successful treatment so far has been the cutting off of all affected limbs several inches below the affected part and burning. The apple is more resistant than the pear; in many instances there will be a line of demarcation between the diseased and the healthy part, and new healthy growth start out immediately below.

CANKER.

This term is applied to diseases which cause the death of definite areas of bark on the limbs or bodies of trees. The diseased areas may be smooth and sunken, or enlarged and roughened, depending on the nature of the organism causing it. Most "cankers," as the term is understood at the present time, are caused by the attacks of some parasitic plant, either fungus or bacterium.

Notwithstanding the fact that these injuries to the bark of living trees have been, in the majority of cases, absolutely proved to be due to the growth of parasitic fungi or bacteria, growers very generally, even at the present time, attribute them to "sun scald" or "winter injury." Lack of knowledge of the nature of fungous and bacterial growth, together with the ease with which responsibility may be shifted upon the weather, have made this opinion the common and natural one. Though there are several distinct canker diseases, the one we shall treat of here is the one that most directly affects us in Pennsylvania.

THE BLIGHT CANKER OF APPLE TREES.

Some writers refer to this disease as body blight. The blight canker, while it may occur on trees of almost any age, is most destructive on young trees just coming into bearing, from eight to fifteen years of age. Through the southeastern portion of the State a large percentage of the trees are affected, both on the trunk and in the crotches, and sides of the larger limbs; spreading from these points of infection, the disease may gradually involve the entire limb and cause its death. Many old trees, weakened by age and neglect are suffering severely, and on looking over these old orchards dead limbs are plentiful. In young trees with smooth bark the disease is easily detected, while in its first stage. They appear as discolored, somewhat sunken areas, the margin along the advancing front being slightly raised or blistered; the tissues in actively spreading cankers are of a darker green than the healthy bark and are very sappy. On damp, cloudy days, drops of a milky, sticky fluid exude from the cankered tissues through pores in the bark. After a short time the diseased tissue begins to turn brown and dry

up. Unless in a very active state of progress, the margins are very distinct, marked by a crack where, in drying, the diseased tissue has separated from the healthy bark. A large percentage of the cankers are active during but one season; the diseased bark is usually killed to the wood, to which it clings the first season; it gradually decays, however, and falls out, leaving the wood bare, but if the tree is in good condition the rapidly forming calluses soon close the wound. In some cases the canker is superficial, never reaching the cambium, except, perhaps, in a limited area at the point of infection; such wounds heal quickly beneath the dead bark, which clings to the tree as a sort of scab. The effect of the canker on the tree is to lower its vitality by cutting off the food supply to the root, and indirectly reducing the flow of sap to the branches and leaves. It acts the same as partial or complete girdling. The effects of canker are first noticed in the foliage; if there is a large body canker the entire tree may show the effects of the trouble. More often the first symptoms are noticed by the peculiar appearance of the foliage on one or more limbs; either these branches fail to leaf out in spring, or if they do, the leaves never fully expand, but remain undersized and curled; they never take on the dark green color of the foliage.

How Trees Become Affected.—The bacteria are frequently carried by insects, which, after visiting freshly cankered sprouts, introduce the bacteria into the succulent tissues of the rapidly growing healthy shoots. Another source of infection is the pruning knife, which has been used to cut away cankered bark. Infection may occur through wounds or bruises on the limbs and bodies of trees, often made by careless workmen when plowing or working about the trees.

Treatment.—With a sharp knife remove all the diseased tissues, swab out the wound with a weak solution of corrosive sublimate, 10 grains to one pint of water; or with a solution of copper sulphate, one ounce to two gallons of water, and when dry, paint the wood thoroughly with some heavy lead paint. This should be done early, as soon as the canker is discovered.

Preventive Measures.—All dead limbs and trees should be cut out and removed from the orchard and burned; cut out and burn every trace of twig blight as soon as detected; keep the body and main limbs free from water sprouts; keep the tops open; avoid excessive fertilizing with nitrogeneous manures; apply some form of phosphoric acid to ripen new growth; spray trees in early spring with lime, sulphur and salt wash.

CROWN GALL.

This is a disease in which enlargements occur near the ground on nursery stock. It is often troublesome on the apple and peach. It

is considered a fungus disease, and is spread by infested trees being planted. All nursery stock affected should be discarded, and the stock burned. In some instances it has been cured by shaving off the affected part and painting the surface with a paste made of bluestone and lime. It closely resembles and is frequently mistaken for the swellings produced by woolly aphis, but may be distinguished by the absence of the insect.

ROOT GALL.

Is also considered a fungus disease, but no investigator has yet been able to discover any insect, germ or fungi associated with the disease. The galls affect the apple, pear, peach, plum and quince. They appear upon any part of the roots, small or large. They may be from the size of a pea to twice as large as a man's fist. Some nursery stock is so badly infested that scarce a tree is free from it; in fact few nurseries are exempt. For several years we have not purchased a bill of trees, from any locality, but we found more or less trees affected. In one instance the stock was so badly infested we destroyed the whole lot. Trees are sometimes affected with large galls just below the crown which completely encircle the stock; trees thus affected cease growing and assume a yellowish and sickly look. The cause of the disease is unknown.

Treatment.—In the orchard where seen the knots should be removed and burned, and an antiseptic paint used for crown gall. If a tree is removed, it would be better to delay resetting, as the soil seems to become infected. Discard all young trees affected.

ROOT ROT.

This disease sometimes becomes serious in orchards planted in new land lately denuded of forest, being full of old decaying stumps and roots. It affects the apple, peach and other trees. The fully developed fungus is a mushroom of honey color, becoming yellow or brown with age; they appear about the base of badly affected trees. The first symptom of the disease is an excessive exudation of gum at the crown of the tree; foliage becomes sickly and the tree dies There is no known remedy, save to avoid planting in newly cleared land.

APPLE SCAB.

There is perhaps no fungus disease of fruits so well known to the public as the apple scab, or black spot. This is due to a fungus which produces the well-known scabby spots upon the fruit and attacks the leaves and green shoots. It first appears upon the leaves in the form of smoky greenish spots, circular in outline; these gradually enlarge and frequently run together, so as to form large

blotches; as they grow older the color becomes darker, finally almost black. The upper side of the leaf is usually affected. Sometimes when the weather is favorable in the spring the fungus develops so rapidly on the expanding leaves as to blight them, dwarfing and killing the younger foliage. In such seasons the newly formed fruit is also attacked by the fungus, which shrivels the young apples and causes them to drop off. The spores or reproductive bodies of the fungus are produced in immense numbers on the blackened spots on the leaf and fruit, forming most abundantly during cool, wet weather. They are carried and scattered by wind and rain. When they light upon a moist leaf or fruit they germinate, by sending out a little tube, and thus form a new center of disease. The spores pass the winter on the bark, twigs and stored fruit, as well as on the fallen leaves and fruit, during the moist weather of spring they start the disease again. The loss due to this disease is very great, amounting to millions of dollars annually throughout the United States. The mycelium, or vegetative portion of the scab fungus, consists of brownish cells which develop just beneath the skin of the leaf or fruit, but, as a rule, do not penetrate deeply into the tissues.

Treatment.—In spring just before the leaf buds open, spray thoroughly with one of the copper solutions, or with lime-sulphur solution, before buds expand, a little later just before the blossoms open spray again with Bordeaux Mixture No. 2; spray for the third time just after the blossoms drop with Bordeaux Mixture No. 2, to which an arsenate has been added for destroying the future codling moth. Trees very subject to this disease will be benefitted by another application a couple of weeks later, but do not use too strong Bordeaux or you will cause russet spots on your apples.

THE BITTER ROT OR RIPE ROT.

This disease is caused by a parasitic fungus which most commonly attacks the fruit as it approaches maturity. The injury is most likely to occur at the calyx or blossom end of the fruit, but it may occur anywhere upon the surface. It gradually spreads from the point of infection throughout the tissues, causing brown and decayed spots as it progresses. The larger fruits usually fall to the ground, but many of the smaller ones shrivel up and remain on the tree in a mummified condition. Great quantities of spores are developed on these withered fruits and by means of them the disease is started again the following spring. The fungus seems to be more destructive during damp weather. This disease is on par with scab, causing great loss to the orchardist. It is no uncommon thing for one-half or more of the fruit on a tree to be rendered worthless by its attacks. In many parts of the country we find in many orchards the ground covered with well grown apples, yet not worth gath-

ering because of the rot. The disease is distinguished after it has become well established by the presence of small blackish pustules scattered over the surface of the apple; these are the fruiting spots of the fungus. The mycelium which has penetrated the pulpy tissue of the fruit in all directions, disorganizing it and causing it to rot, here develops a large number of cells, which rupture the skin of the apple and produce spores at the tips of slender projecting threads; these spores are blown off by the wind, or washed down by the rain. When one of them lodges upon another apple, where sufficient heat and moisture are present, it germinates, by sending out a little tube, and may thus start the disease in a new situation.

Treatment.—The first step toward prevention of this disease is the removal and burning of the mummified fruit on the trees; this should be done during winter; the Bordeaux mixture treatment recommended for apple scab may be used for this disease with decided benefit.

Several other fungous diseases affect the apple—apple rust, powdery mildew, &c.—but they are not sufficiently troublesome in Pennsylvania to cause much loss; should they become so, remove the cause of infection and treat with the copper sprays in some form.

PEAR.—(*Pyrus Communisand Pyrus Sinensis.*)

The many pears we have at the present day belong to one or the other of these species, or crosses between the two. All of the finer groups of pears belong to, or are derived from Pyrus Communis. Another group of pears known as the Kieffer group, commonly spoken of as hybrids, which have been so extensively disseminated in recent years, and combining the character of the two species, are doubtless a cross between the two.

The pear has never become so popular in America as the apple. In fact, it is rarely we find an expert judge of pears in this country. European countries take much greater interest in this fruit. With Germany and France it is much more popular, better understood, and very much finer distinctions are made in characterization and classification.

This orchard fruit adapts itself to a wide range of country, but is more successfully raised in the New England and Eastern states, and along the Pacific slope. In the Southern states the fine varieties do not thrive and are very susceptible to blight (the Kieffer group being the exception, doing rather better in the Southern states than Northern). Much of the Northwest is too cold for the pear, except some of the Russian sorts of inferior quality. Pennsylvania has in recent years taken more interest in the propagation of the pear com-

mercially, many large orchards having been planted, principally with Kieffer, Le-Conte and others of the same group, and have, where intelligent care has been given, proven remunerative to the owner.

STOCK TO PLANT.

There are more failures with the pear, due to varieties being budded or grafted upon uncongenial stock, than any other cause. In former years, when all our nursery stock was worked upon the French root, there was little trouble with stock that was carefully handled and planted, but with the advent of the Oriental varieties, when nurserymen found that they could get a much better stand of better rooted trees to sell their customers, they availed themselves of the opportunity and used the stock almost exclusively, thereby pleasing their customers and putting money into their own pockets. But alas for the hopes of the planter! In nearly every instance the trees all grew, many varieties making a good showing for a year or two, then something seemed wrong; the trees made little growth, the bark does not have that bright appearance, the soft elastic feel that a healthy growing tree has, the foliage loses its rich, green color. The planter becoming alarmed, looks for the cause. A wise neighbor suggests worms; he digs the ground from around the trees, but finds nothing to cause the trouble, finds clean, healthy appearing roots and a perfect union between stock and root. He then concludes the soil is too poor and puts a heavy coat of manure around each tree, even piling it up close around the tree to be sure it will get all the strength there is in it. (The same thing is done every year by farmers all over the country. Every fall they pile stable manure around their trees and grape vines, expecting to feed and protect them, not knowing that the hungry, feeding roots are often yards away, and cannot get any of it, and what they considered a protection makes comfortable winter quarters for the short-tailed field mice, which live upon the bark, removing all within reach.) If he is fortunate enough to escape the mice, he finds the tree does not respond, but makes a short, sickly growth for a year or two, and dies. The following spring when he digs the tree out to make place for another he is surprised to find fine, healthy roots in every instance. He plants another set with the same results. After a few trials he becomes disgusted, claiming pears will not do any more. But among the lot are several that make a strong, continuous growth, come into bearing and continue healthy. A neighbor gets a lot of trees of the same varieties, the same year, from another nursery. The varieties that died for Mr. A all grow, making healthy, productive trees; but the variety that grew for Mr. A made

fair growth and bore such poor fruit that it was worthless for Mr. B. Now let us see what the trouble was.

Mr. A bought his trees, Bartletts, Seckel, Clapp's Favorite and Kieffers, all budded on Japan roots. The Japan roots not being congenial to the European varieties, they all perished or yielded no profit to Mr. A. But the Kieffers, being hybrids, of Oriental origin, the stock was congenial. They grew and produced profitable crops of choice fruit. Mr. B bought his trees budded on French stock, which being congenial to his Bartletts, Seckels, &c., did well. But his Kieffers, being of Oriental origin, were not congenial to the French root, therefore were a failure. I had experience along this line. Many years ago I had a lot of fine, healthy LeConte trees. I top worked them to Seckel, Bartlett, &c. The grafts nearly all grew, but with different results. The Seckels lived, but made slow growth; they bore heavily, but fruit was not up to the standard. The Bartletts grew for a year or two with diminishing vigor; not one out of several hundred survived the fourth year, and not one produced fruit. In the spring of 1896 I planted two rows of pear trees, about fifty in each row. These trees were all on Japan roots, and all choice stock. In one row I planted alternately Kieffer, Garber, Kieffer, &c. In the second row I planted Kieffer, Bartlett, Garber, Kieffer, Bartlett, Garber, &c., having thus every third tree a Bartlett. Now for results. The Kieffers and Garbers are today trees any horticulturist might be proud of (I know some will claim no man can be proud of a Kieffer, but such have never learned how to raise a Kieffer) producing annually from two to five bushels of choice pears. But sad to say, not one Bartlett survived the fifth year, and but one bore any fruit, and that very inferior. Years ago, when we all thought the Japan root was just the thing, I sold hundreds of trees on the Japan roots and I do not know one that is living today. But in every instance where they were on French root, they not only grew but are today fine, thrifty, profitable trees.

When you buy European varieties, insist upon having them on French stock. Take no others. When you buy Oriental varieties, insist upon having them on Japan roots, or on their own roots, raised from cuttings. Follow this rule and you can plant pears with success.

SOIL.

The soil best adapted to the pear is a stiff clay loam, or even hard clays when well drained. Many successful orchards are located upon lighter soils, but in such situation the trees tend to make too rapid and succulent growth, and thus become more subject to diseases and winter killing, and the orchards are short lived.

PLANTING.

The same careful preparation of the soil is just as essential and is practically the same as for the apple orchard. Deep plowing and thorough cultivation are the keys that unlock the doors to successful fruit raising, and the pear is no exception. Clean culture should be kept up until the middle of July. Hoed crops may be planted between the rows, which in standard sorts should not be less than twenty or twenty-five feet each way; dwarf varieties about fifteen feet each way; thus affording room between the former for five to seven rows of potatoes the first two years, gradually lessening the number of rows until at the end of five or six years, when the trees require the entire space. I believe crops of this sort are beneficial, not that they add anything of value to the growing trees, but they make an incentive for better culture. If no crop is planted the orchard is apt to be neglected in cultivation and fertilization, but if some crop is planted, like the potato, there is generally a liberal application of manure of some kind, and the crop is cultivated to keep down weeds. The trees get their proportion of both, and respond by making a strong, vigorous growth, sometimes too much so, as the majority of farmers have more stable manure than they have money to purchase suitable fertilizers. They therefore give the ground a heavy application of this rich nitrogeneous manure, and thus push the growth of the trees, rendering them susceptible to that terrible scourge, the pear blight. If there was less nitrogen and more phosphoric acid and potash applied, the trees would make a more healthy, sturdy growth, with firm, well ripened wood, capable of resisting the action of the blight. The crop of potatoes would also be much heavier, and amply pay for the purchase of the fertilizer. If the soil is fairly fertile, but little fertilizer will be required until the orchard comes into bearing, after which an annual application of dissolved rock and muriate of potash should be given. A good mixture consists of 200 pounds each of ground bone, acid phosphate, and muriate or sulphate of potash. Wood ashes (unleached) are very valuable. Should the trees not make sufficient growth, and the foliage assume a yellowish green tint, showing a lack of nitrogen, this may be remedied by growing some cover crop (the legumes being the best) and turn it under. This will furnish the nitrogen in the best form and also furnish the necessary humus to keep the soil loose and retentive of moisture.

PRUNING.

This subject has been pretty thoroughly discussed under the head of pruning. One of two forms is generally adopted for the pear, the pyramid and the vase form. Both are good forms; the one to adopt should be the one to suit the taste of the grower. The method

adopted at the Paragon Orchards; I first train to a pyramid until the trees come into bearing, after which I prune the tops harder, and the laterals but little. My reasons for this method are, first, by the pyramid form I avoid all forks, no two branches coming out opposite each other, therefore no danger of splitting apart of heavily loaded trees; secondly, after this object is accomplished, and I have the perfect head with strong, sturdy laterals, I wish to avoid the tall trees obtained if the pyramid form is persevered in; therefore I now prune back the tops to the desired height, throw more nourishment into the laterals, prune these just sufficient to keep the tree in good form, with an abundance of healthy fruit spurs along all of the branches, and cut out all surplus wood. You will be surprised what an immense crop of fine, well developed. well distributed fruit of the highest quality the trees will be capable of bearing without injury to the trees. By this method I secure many advantages, the principal ones being, tree less affected by storms, convenience in spraying, thinning and harvesting the fruit.

THINNING.

The pear needs more thinning than any other fruit (save the peach and plum) to prevent the trees from overbearing, to improve the quality, size and marketableness of the fruit, and to produce annual crops. To attain best results in size and quality, the fruits should not be left closer than six inches, all wormy and inferior fruit should be thinned out.

HARVESTING.

The pear differs materially from most other fruits by being improved in quality by picking before it is fully ripe, and then ripened up in a closed room or packed in boxes and allowed to ripen. They should be carefully picked by hand, without breaking the stem, when they have reached maturity, and the fruit begins to show very slight color. They mellow and color up beautifully in storage, but if left exposed where air can blow over them they shrivel instead of ripening. If placed in cold storage the temperature should be kept at 32 degrees F.

DWARF PEARS.

Some varieties do very well when dwarfed. It seems to improve them. The Duchess grows larger and attains a better quality when grafted on the quince. The Bartlett and some others, unless double worked, fail to make a perfect union with the quince, and frequently break off under the strain of a heavy load of fruit or in severe

storms. To overcome this some strong growing varieety that forms a perfect bond with the quince is first budded, then the Bartlett or other variety is budded on this.

The dwarf trees are very suitable to plant in small yards, as they occupy but little space and many varieties are very productive. But commercially the standards are the more protable.

VARIETIES.

Commercially, but few varieties are profitable. The most dependable varieties are the Bartlett, Seckel and Kieffer. Among the dwarfs, the Duchess, double-worked Bartlett and Louise Bonne de Jersey are the most profitable.

BEURRE GIFFARD.

Origin, France. Tree a slender grower, not an early bearer, but very productive when in full bearing. Size medium, pyriform; greenish yellow, with considerable red in the sun; flesh white, melting, juicy, vinous, perfumed. Early summer. One of the best early pears and should be on every farm.

OSBAND SUMMER.

Origin, New York. Tree moderately vigorous, upright, an early and abundant bearer. One advantage in this pear, for family use, is its extended time of ripening, often over a period of three weeks. Fruit medium, obtuse-pyriform; yellow, dotted with green and brown dots, thin russet, red cheek in the sun. Midsummer. Valuable for family use, but of little value commercially.

CLAPP'S FAVORITE.

Origin, Massachusetts. Tree an upright, spreading, open grower, very productive; carries its fruit evenly distributed. Fruit large, obovate; pale yellow, marbled and splashed with dull red and light brown; flesh white, fine grained, juicy, melting, buttery, rich, perfumed, sweet. Ripens about ten days before Bartlett.

BARTLETT.

This pear is more extensively planted than any other variety with the exception, perhaps, of the Kieffer. Origin, England. Tree a moderately thrifty, upright grower and very productive. Fruit large, obtuse-pyriform; bright, clear yellow when fully ripe, sometimes a little russet; flesh white, buttery, juicy, musky perfume. Late summer. This is one of the good pears that succeeds everywhere. It is one of the best canners, excellent for dessert, profitable to plant commercially. A very early bearer.

BEURRE BOSS.

Origin, Belgium. Tree a moderate but very crooked grower in the nursery. Many nurserymen do not raise it on account of its slow growth and crooked habit, giving few first-class trees. Those wishing this really valuable pear should top work it on some strong growing European variety, as none of our finer pears do well grafted on the Japan varieties or any of the Kieffer group, as this stock does not seem congenial. Fruit large, very distinct pyriform, neck very long and very narrow, acute, body broad; surface nearly smooth, deep yellow, russeted in patches; stock an inch and a half long, slender, curved; basin very shallow; flesh juicy, buttery, rich, perfumed, sweet, excellent. Autumn. Worthless as a dwarf. This variety would be valuable commercially if top worked. Its beauty and good quality make it a ready seller.

BEURRE CLAIRGEAN.

Origin, France. Tree very vigorous, with erect habit and large, rich green foliage. An early and abundant bearer. Fruit large to very large, pyriform; yellow, shaded with orange and crimson, with brown dots; stalk short, stout, fleshy, oblique, basin shallow; flesh white, slightly granular, buttery, melting, with a rich, very good flavor. Late autumn or early winter. The large size, beauty and productiveness make this pear a profitable market variety. This is a good variety to plant commercially, but in planting be sure they are budded on French stock.

DUTCHESS D'ANGOLEME.

Origin, France. A strong, vigorous grower, but not a profitable pear as a standard, but when budded in the quince it is a very valuable pear, producing heavy crops of the largest size fruit. Season October in Pennsylvania. Fruit very large, oblong-ovate, greenish yellow, with more or less russet spots and streaks; flesh white, buttery, juicy, excellent. This pear is very suitable as a dwarf in scall yards or gardens, needing but little room and yielding abundant crops.

D'ANJOU.

Origin, Belgium. Tree is a vigorous, healthy grower, making a very large, open-headed tree. Not an early, but a very heavy bearer with age, producing annual crops, having its fruit distributed evenly over the entire tree. Season, late fall. Can be kept for several weeks. Fruit is large, short or blunt pyriform; skin greenish yellow, slightly russeted, dull crimson dots, and sometimes shaded with red in the sun; flesh whitish, melting, juicy, brisk, vinous, perfumed, pleasant. Requires ten or twelve years to come into heavy bearing, but after that age it is very prolific.

HOWELL.

Origin, Connecticut. Tree an upright, vigorous grower; an early and abundant bearer. Fruit large, roundish-pyriform; light yellow, with a clear, red cheek; flesh whitish, juicy, melting, vinous. Early midsummer. This variety adapts itself to a large extent of country. Any one will do well to plant it.

LOUISE BONNE.

Origin, France. Tree vigorous, upright grower, and a very heavy bearer. This is one of the old tried sorts, not of the highest quality, but satisfying. Requires rather a stiff clay to do its best. This is one of the best varieties as a dwarf. Fruit large, long pyriform; greenish yellow, mostly overspread with brownish red, and a red cheek in the sun; flesh melting, very juicy, rich, vinous, excellent; profitable for market.

LAWRENCE.

Origin, Long Island. Tree only a moderate grower, but with me a very early and heavy bearer. Where this pear does well it is a late fall pear of the highest quality, but in many locations it has a very rough skin and hard at the core. Requires good culture. Fruit above medium, obovate, obtuse-pyriform; clear, light yellow, with more or less russet, minute dots; flesh juicy, melting, sweet, aromatic. Late fall and early winter. The most valuable early winter pear we have. Brings the highest price in the markets.

LINCOLN (Not Lincoln Coreless.)

This variety is but little known in the Eastern states, and but few nurseries propagate it. But when its many excellent qualities become better known it will make for itself a prominent place among the fancy pears. Tree is a strong, rapid, though somewhat straggly grower, requires considerable intelligent pruning to hold it in good form. It comes early into bearing and bears heavy crops annually. Whether it will adapt itself to a wide range of country can only be ascertained by testing, but it is very hardy and I believe it will prove valuable throughout Pennsylvania. At the Paragon Orchards it is our leader. We think so much of it that all other varieties not coming up to the standard will be top worked to this variety. Fruit is large, obovate pyriform; skin beautiful, clear yellow; always smooth and good form; seldom shaded; dots numerous; flesh whitish, melting, juicy, vinous, highly perfumed. A basket of these pears scents a whole cellar. Season, late September and October. This pear will bring the highest prices in any market. It should be tested on every

farm, but do not make the mistake and plant the Lincoln Coreless, which is a worthless variety, being neither coreless or anything else that is good.

SECKEL.

Origin, Pennsylvania. It is with pride we can claim having originated the pear that stands as the standard of excellence among pears, by which the quality of all other fine pears are gauged. The tree is a slow but healthy grower, forming a handsome round head. It takes longer to bring this variety into profitable bearing than many stronger growing varieties, but when size is acquired it makes up for lost time by bearing immense annual crops of the highest priced and highest quality pears that go into the markets.

There are certainly two strains of this pear. The one as we commonly see it is small, roundish-ovate; dull, yellow-brown, with a russet red cheek; flesh buttery, very juicy, rich, spicy, aromatic. Early autumn. As we are raising it on the Paragon Fruit Farm, the fruit is much larger, two or three times as large, nearly the same shape, a little more flattened at the flower end, color brighter, quality the same. The latter is a much better type than the old well-known favorite and will bring much higher prices.

SHELDON.

Origin, New York. Tree hardy, vigorous, upright grower, forming a handsome round head; a very heavy bearer. Fruit medium, roundish; greenish yellow, with a thin, light russet and a bright red or crimson in the sun; flesh very juicy, melting, vinous, sweet, aromatic; like many other pears it must be gathered before fully ripe or it will become core-rotted. A very valuable pear, a good seller.

VERMONT BEAUTY.

Tree very hardy, moderate but healthy grower. A very abundant bearer. Fruit medium, yellow, with a beautiful red cheek in the sun; flesh whitish, juicy, rich; quality the best, almost equal to the Seckel.

RUTTER.

Origin, Pennsylvania. Tree a strong grower while young. Comes into bearing early and is very productive, producing large crops annually. Fruit medium to large, roundish pyriform. Skin greenish yellow, nearly covered with dull russet. Sometimes rough, not attractive when taken from the tree, and would be a poor seller at that time; flesh whitish-yellow, a little granular, juicy, slightly sub-acid before fully ripe, but when fully ripened it is one of the richest

high flavored aromatic pears grown, and as long as there are any of them about nothing else in the pear line will be eaten by old or young at the Paragon Farm. As they mature, they lose their objectionable color and take on that soft golden russet color so tempting to the appetite. This pear is valuable and should be planted by every lover of good fruit; but do not judge it at time of harvesting; it is then a diamond in the rough, to be developed by time into a gem of the finest quality.

ROSNEY.

A vigorous grower, hardy in wood and bud, but moderately productive. Season, last of August or beginning of September. Fruit large, roundish pyriform; skin creamy, with crimson blush; flesh melting, juicy, sweet and tender, of superior flavor. At the Paragon Farm the fruit is all we could desire, but it lacks quantity, as the tree is proving a shy bearer. Perhaps it will become more productive with age. Would not recommend it commercially.

WORDEN SECKEL.

A seedling of the Seckel. The tree is more upright and rapid grower than the Seckel, hardy and prolific bearer. Fruit keeps well, retaining its flavor to the last. Fruit medium to large, often as large as Clapp's Favorite, which it closely resembles, but in all other respects it is a Seckel with all its good qualities, worthy a place in every orchard.

WINTER PEARS.

Which is the best? I have never seen it. I have tried many, but chosen none. All have serious faults. The majority are not winter pears at all, unless kept in cold storage, and a cold storage pear is, in my estimation, as near worthless as any edible fruit can be. Among the best we may class

WINTER NELLIS.

This would be a truly valuable winter pear were it of larger size, but as ordinarily grown it is entirely too small, and often very inferior in quality. The tree is a very slow, slender, irregular grower, taking many years to make a tree. It should be top worked. When it comes to bearing it is such an abundant bearer that unless it is thinned the fruit remains so small they never get character. Fruit below medium, roundish obovate, yellowish green, patched and marbled with russet; flesh fine grained, buttery, very juicy, sugary, aromatic, good for home use, too small for market.

VICAR OF WAKEFIELD.

Origin, France. Tree a healthy, vigorous grower, a heavy bearer, but as ordinarily raised it is good only for cooking. When raised to perfection the fruit is large, long pyriform; pale yellow at maturity; often, when well grown, with a brownish red cheek; flesh moderately juicy, half buttery, often slightly astringent; quality only medium, never strictly good. In some sections this variety is profitable as a market fruit.

PRESIDENT DROUARD.

Tree rather slow grower with peculiar, oak-like foliage. Claimed to be a very prolific bearer of large, melting, juicy, deliciously perfumed fruit. Season, February to March. I have the trees fruiting for the first time this season, and according to present indications they should keep that length of time, with a high temperature to bring them into a melting condition. I am in hopes they will sustain the high praise given them.

GLOUT MORCEAN.

Flemish origin. Tree is of a roundish, spreading habit, very healthy and hardy. Not an early bearer, but with age becomes very productive. Very subject to pear blight. Fruit large, varying in form, usually short, pyriform; greenish yellow, with patches and dots of greenish brown; flesh white, fine grained, buttery, melting, rich, sugary; season, early winter. Few people have ideal storage for fruits of this kind, being too changeable, too dry, too warm. The fruit wilts before its good qualities become developed.

JOSEPHINE DE MALINES.

A late winter variety. Tree a moderate grower, hardy, foliage small, very productive. Fruit medium, roundish, flattened; pale yellow or straw colored at maturity, sometimes netted and patched with russet; flesh white, tinted with rose, juicy, melting, sweet, slight aroma. Considered one of the best of late winter varieties.

BEURRE EASTER.

Very late winter. Tree only a moderate grower, making a compact, upright, round head, bearing heavily. Not as hardy as some varieties, requiring a warm exposure, if grown in the northern part of the State. It requires very rich soil, good culture, careful thinning to bring it to perfection. Fruit large, roundish oval; yellowish, more or less russet in dots, which sometimes gives it a brownish cheek; flesh fine grained, melting, very buttery, juicy and sweet. This fruit can be kept until April, under good intelligent culture, and properly ripened. This variety is valuable, but it would be waste of time and

money for the ordinary, do as you can, farmer to plant it. Failure would be inevitable.

In these few pages I have given, in a condensed form, the description and quality of the best varieties grown, adapted to Pennsylvania. The majority of them can be raised successfully with proper care in almost any part of the State. All of them will prove a failure under neglect.

The subject would be incomplete without a few words about the Orientals. These varieties are so hardy, so prolific, growing with so little attention, that they are being planted in some sections to the exclusion of the finer sorts. They certainly have much in their favor; they will grow in almost all localities, in all soils not too wet. Some of the varieties produce fruit for culinary purposes and for canning above the ordinary, and some of them are so resistant of disease and insect pests, like the San José Scale, that the scale avoids them to save their lives.

The most popular among the hybrids are

THE KIEFFER.

Better known and more generally planted than any other variety. Tree a strong, upright grower. Requires very hard pruning to keep it in good shape, that it can bear its heavy crop of fruit without breaking the entire tree to pieces. It is seldom one sees a good formed Kieffer, owing to neglected pruning and overbearing. Fruit large to very large, known by its shape, being best described as barrel shaped. Skin rough, yellow, sometimes russeted, with beautiful blush on sun side; flesh whitish-yellow, rather coarse, as mostly grown sandy at the core; juicy, with a flavor peculiar to itself; quality poor. But the pear responds to intelligent care when budded on Japan root; trees well pruned, given abundance of phosphoric acid and potash, fruit thinned early, gathered just when assuming a slight yellow tint, placed in boxes in a dark place to ripen, they develop qualities above the average, with flesh free from all sandiness, very good to eat out of hand, and for canning superior to most.

LE CONTE.

Another Oriental that has made for itself a reputation as a pear when understood, equal to the finer European varieties. It is a favorite in the South, being very profitable as a very early market sort. They are picked before fully grown, in June, wrapped, packed in boxes and shipped to northern markets. They ripen in transit, and arrive at destination in a very attractive form, commanding high prices, often $2.00 to $3.00 per bushel box.

The trees are strong growers, prolific bearers of beautifully formed, uniform fruit, which, when properly ripened, has few equals

and no superiors in beauty. As an eater it equals the average; as a canner it excels the best. But if left to overbear, the fruit remains small but always fair. If left to hang on the tree too long it core-rots. There are several varieties of more or less value, as Garber, Smith's Blight Proof, &c. These varieties are all valuable where other varieties of European origin cannot be grown, as none of these varieties do well south of latitude 32 degrees north.

In treating varieties, I have left a great many old friends out, not because they have no good qualities, but out of the many I have selected the few, and for commercial purposes this list would have to be again culled. Then it would stand like this: Bartlett, Lincoln, Seckel, Beurre d'Anjou, Rutter, Kieffer.

The man that would have the courage to again cull, planting only Bartlett, Lincoln, Kieffer, would swell his bank account above his most sanguine expectations.

DISEASES.

The pear is subject to many troublesome and injurious insects.

PEAR TREE BORER.

This insect attacks the trunk. It is injurious only in the larva state. This resembles the larva of the peach borer, but is smaller. It feeds upon the inner layers of the bark of the pear tree. It can be detected by the castings resembling fine sawdust, which it throws out.

The moth is a small, wasp-like creature, which measures about one-half inch across the expanded wings.

Remedies.—Search must be made for the larva, and destroyed by cutting out with a sharp knife. As a preventive measure, paint the trunks with a mixture of soft soap and soda, or mound the trees about midsummer with ground, as recommended for peach tree borers.

PEAR TREE BEETLE.

The work of these small beetles can be distinguished from the fire blight disease (which is the result of a species of bacteria) by the small perforations like small pinholes at the base of some of the buds and from these issue small cylindrical beetles about one-tenth of an inch in length, of a deep brown or black color, with antennae and legs of a rusty red. The beetle deposits its eggs at the base of the bud and when hatched the young larva follows the course of the eye of the bud toward the pith, around which it passes, consuming the tissues in its course, thus interfering with the circulation, and

causing the twig to wither. The larva changes to the pupa, and after to a beetle in the bottom of its burrow, and makes its escape from the tree the latter part of June, or beginning of July, depositing its eggs before August has passed, the hole made by the insect in escaping is a little more than 1-20 of an inch in diameter. Trees weak in vitality are more subject to them, but healthy trees are also attacked and sometimes severely injured by them. They are not limited to the twigs, but attack the trunk also. In some seasons there are two broods. The injuries inflicted by this insect are not confined to the pear, but the apple, apricot and plum are also affected.

Remedies.—The only known one is to cut off the blighted limb below the injured part and burn before the beetle escapes. Pear blight is often confounded with this; will be treated under the head of fungus diseases.

PEAR TREE BARK LOUSE.

This insect is not plentiful, and where trees are sprayed with the lime-sulphur-salt sprays there will be no trouble from them.

PEAR TREE PSYLLA.

During the month of May, when growth is rapid, the smaller limbs and twigs of pear trees are sometimes observed to droop. A close examination reveals a copious exudation of sap from about the axils of the leaves, so abundant that it drops upon the foliage below, and sometimes runs down the branches to the ground. Flies and ants gather in crowds to sip the sweets. With a magnifying lens the authors of the injury may be observed immersed in the sap about the axils of the leaves.

This insect is known as the pear tree psylla, a small, yellow, jumping creature, flattened in form, and provided with short legs, a broad head and a sharp beak. With the beak they make the punctures from which the sap exudes. They sometimes become so numerous that every leaf on the tree seems to be affected, all growth is at once arrested and the tree loses a considerable portion of its leaves. The color of the pupa is a deep orange red, the thorax striped with black, the abdomen blackish brown. Toward the end of the summer they attain maturity, when they are furnished with transparent wings, head orange color, abdomen greenish, about one-tenth of an inch in length.

Remedies.—One of the soluble oil sprays, given under the head of soluble oil sprays.

THE PEAR TREE SLUG.

This insect is the larva of a species of saw-fly. It is while in this state that it is injurious to the pear and cherry leaves. The first brood

makes its appearance early in June. The second brood comes early in August. It is a disgusting looking, slimy, blackish or olive brown slug, with the anterior part of its body swollen so as to resemble a tadpole. The head is small, of a redish color. It feeds upon the upper side of the leaves, consuming the tissues, leaving only the veins and under skin. The foliage deprived of its substance withers and becomes dark colored, as if scorched by fire, and soon afterward it drops from the tree. In badly infested orchards whole rows may be seen denuded of their foliage during the month of July. In such instances the trees are obliged to throw out new leaves; this extra effort exhausts the tree of its vitality to such an extent as to seriously interfere with its producing power the following season.

Remedies.—Hellebore, in powder, mixed with water, one ounce to two gallons of water, and sprayed over the tree; any of the soluble oils in very dilute form; air slaked lime dusted over the foliage; even road dust will destroy them. I have pear trees along the public highway, which is much traveled, and the leaves are dusted daily during dry weather. These trees are always free from the slugs.

Many of the masticating insects, as the caterpillars, grasshoppers, &c., often become so numerous that they seriously injure the foliage. They can be destroyed by the use of one of the arsenites diluted with water and sprayed over the trees. This will effectually destroy them.

FUNGI AFFECTING THE PEAR.

PEAR LEAF BLIGHT.

This is probably the most generally destructive fungus disease to which the pear is subject. It appears early in the spring, soon after the leaves develop, usually revealing its presence at first by minute dull reddish spots on the upper surface of the leaf. A little later spots appear on the lower side also, and the reddish tint gives way to brown, with a darker center. As the fungus develops the spots enlarge, involving more and more of the tissues of the leaf, until the tissues directly affected within the spots and those indirectly affected between include nearly or quite the entire leaf, which appears sere and brown. Very young leaves sometimes curl up as a result of the attack. The quince is also affected by this disease. When leaves are badly injured they fall off, and whole orchards are sometimes defoliated by the disease. This is of course very injurious to the trees; they are unable to store up the materials of growth properly, and become weak and impoverished. But this fungus does not confine itself to the foliage; the stems and fruit are also attacked. The former becomes black and dead; the latter is at first covered with reddish pimples, which finally become blackened and roughened, and

cause the pear to crack in such a manner as to ruin the fruit. This disease is especially destructive to young nursery stock and causes them to lose their leaves.

Treatment.—Spraying while trees are dormant, with lime, sulphur solution, or solution of the copper salts. Spray with Bordeaux or the ammoniacal solution of carbonate of copper as soon as the leaves begin to unfold. Repeat the operation two or three times, at intervals of two weeks; discontinue the treatment when the fruit is half grown. Too strong Bordeaux has a tendency to cause russet spots on the fruit.

PEAR BLIGHT.

This disease is now known to be due to the presence of a specific germ—one of the bacteria—so minute as to require the aid of a powerful microscope to see it. Pear blight is easily distinguished by the blackened appearance of the affected parts. For a further description and treatment, the reader is referred to the article under the head of fungus diseases affecting apple trees.

THE PEAR SCAB.

This disease is similar to apple scab, the fungus being believed to be the same species. The chief points of the life history and the treatment are the same. Care should be taken not to apply the Bordeax mixture too late in the season. Early varieties should have but one spraying with this mixture after the fruit sets, and late varieties two. Where additional applications are necessary, use the copper carbonate solution. The reader is referred to apple scab for description and treatment.

The size of this Bulletin will not permit more space to be devoted to the pear and its treatment.

PEACH.—(*Prunus Persica*).

The peach is grown over a very wide range of country, but it is only recently that any one has attempted to raise it commercially outside of a prescribed area. In former years it was thought that Delaware, Maryland and New Jersey comprised the entire peach belt; but it has been gradually widening until there is now scarcely any throughout the southern, middle and northeastern, as well as western and southwestern portions of the United States that can not and does not raise this delicious fruit in its highest state of perfection, for home use and commercially. In fact, those states that once held the honor of being the great peach states, produce at the present time but a very small proportion of the millions of baskets that are consumed annually in our large cities.

Peaches were raised commercially in the United States more than a century ago. Mention is made in a Bulletin, issued by one of our states, of the early history of peach growing in Delaware, dating it back to 1832, when the first orchard was set near Delaware City, in the Northern part of the state. But to get at the early history. we must go back more than half a century further, as we have the authentic accounts of large orchards of from 50 to 70 acres being planted in Kent County, Delaware, previous to 1807; and the industry was carried on extensively many years previous to this. In the memoirs of the Philadelphia Society of Agriculture, which was formed in the year 1785, in volume I, published in the year 1815, on page 188, there is a communication from Richard Peters to Dr. James Mease, secretary of the association, bearing date December 8th, 1807, on the peach. Among other items he states: "In Kent County, Delaware, they cultivate the peach tree without diffculty or risk. Although the common mode is to plant the young trees grown from the stone, without budding, or engrafting, yet some crack the stones and so plant them; others take out the kernels and plant them with their corn, dropping two (to insure one) in a hill, at about twenty-five apart, in squares. They tend the corn field in the usual way; and the young trees grow with the crop, to the height of three or four feet, in one season. Large orchards are thus obtained at small expense."

Further he says: "There are large orchards of fifty to seventy acres and some larger in Acomac and other parts of the isthmus, between the bays of Chesapeake and Delaware, further south the more sandy the soil, the better the fruit; nor should it be over-rich. Peach orchards are planted to ameliorate poor lands." The disease ca'led the yellows was also prevalent at this early date, and not, as many suppose, of more recent origin. In reference to it he says: "The yellows are universally prevalent, this season, throughout the country. I do not wish to discourage perseverance in the culture of this tree. But, when particular products often fail, they warn us to apply our main strength and resources to other objects more certain and equally profitable. Let hazardous cultivation be collateral and subordinate."

That the Hoodoo Doctors were around in those early days with the same remedies that have been in later years resurrected to entrap the unwary, is shown where he states, "The Mercury, as mentioned by Dr. Tilton, for the cure of the disease in peach trees, I have frequently applied to plums. I bored a gimlet hole through the bark, and about half an inch into the albarnum, or sap-wood, and inserted a drop or two of crude mercury, so as to be carried through the circulation, with intent to destroy vermin or insects in the bark or fruit. I have sometimes had plenteous crops, apparently from the remedy; but I have more frequently been disappointed."

Among the states forging to the front as peach states, Pennsylvania is one of the most prominent. Wherever judicious selection of location and soil has been made, and intelligent culture given, the results have been very satisfactory, the climate being very congenial, the happy medium that is so well adapted to the best production of the most of our fruits; and the time is not far off when many of our rough mountain lands will be devoted to the peach.

There are five distinct races of peaches cultivated in the United States: The Persian, the Northern Chinese, the Southern Chinese, the Spanish, and the Peen-To, the geographical names representing the parts of the world in which each race is supposed to have originated or to have reached its highest development. But a geographical name is objectionable, for it is probable that all types of peaches originally came from some part of China. We have no definite information concerning the number, the origin, or the distribution of the types in their native homes; it is therefore, not proper to apply a geographical name to a distinct type or group, before something is known about it in the country to which it is indigenous.

The so-called Persian race is composed of a number of distinct types of peaches, and crosses between these types. These types vary greatly botanically, as well as in their geographical adaptability; some of them being much more hardy than others, and must have originated in climatic conditions widely dissimilar. Then we find some of the types of the Chinese group correspond to different groups of the Persian race. It is likely, therefore, that several distinct types of peaches have been developed in the cooler climates of China.

The selection of types and varieties of types is a very important matter with the prospective fruit raiser; upon this selection depends to a large extent his success or failure. There are many climatic conditions existing in the United States and the selection must be made according to the section of the country where the orchard is to be planted. In Florida the Peen-To type and their many crosses are peculiarly adapted; being extremely early, they mature their fruit long before the other types, therefore commanding remunerative prices; but they are very susceptible to cold and will not stand even light freezing, so it would be folly to plant such varieties in any portion of Pennsylvania. We must have hardy varieties, such as will withstand severe freezing, several degrees below zero. What type shall we select from? There are some varieties of the Persian type that are fairly hardy and will stand ordinary winters if properly handled; but we must look elsewhere if we wish safety; in extraordinary cold winters we wish varieties that can withstand fifteen to twenty degrees below zero. Are there such? As the ordinary orchards are treated, no. If the previous year's culture has

been of the proper kind, then we can safely say, yes; as we have on more than one occasion passed through winters when the thermometer registered 10 to 15 degrees below zero, and had bountiful crops. We have also had open blossoms and young fruit frozen solid without injury, when all surrounding orchards were killed, in some instances even the wood.

The hardiest type are the Chinese cling group, and varieties from this group are the safest to select. The question may arise, have we a sufficient number of varieties from this group to fill the season from early to late? The planter generally selects too many varieties, thereby getting too large a proportion that are not profitable. From my observation and experience I find that the larger proportion of the catalogued varieties had better be let alone. It is well to test new and promising varieties, but do not plant extensively of any variety until it has earned a reputation. And it should be borne in mind that a variety that is prolific in Delaware may be a shy bearer in Pennsylvania, as the environments modify the variety, and each one needs to be thoroughly tested under widely varying conditions before its value can be judged. In giving a list of peaches a great many of the old varieties will be dropped, not because they are worthless, but because they have served their time and are superseded by others of more merit. Varieties will be given alphabetically.

BELLE OF GEORGIA. N. CHINA GROUP.

Originated 1880; introduced in 1889 by P. Y. Berkman. Size large, creamy white, a blush cheek and crimson mottlings at base; flesh white, slightly red near the stone; melting, juicy, vinous and of the highest quality. This is one of the leaders at the Paragon Fruit Farm. It surpasses any variety ripening at the same time; matures the latter end of August and early part of September in latitude 40; later farther north, and earlier farther south; tree comes early into fruiting and is very prolific.

CARMEN. N. C. TYPE.

Parentage unknown; originated and introduced by Mr. Y. N. Stubenrauch, Mexia, Texas. Tree is a strong, vigorous grower and very productive. Its earliness, large size and attractive appearance make it very valuable. Fruit large, round, compressed; cavity large, open, creamy white, marbled over one-half with delicate red; suture indistinct, except a slight depression at cavity; apex round, blunt, short; color creamy white, thinly pubescent; skin firm; flesh dull white, slightly stained, soft, juicy, fine texture; stone semi-free; flavor sub-acid, vinous; quality very good, ripens early in August. At the Paragon Fruit Farm this is one of the leaders; colors beautifully and produces enormous crops.

CHAMPION.

Originated in Illinois. Tree a very strong, robust grower, very hardy in bud; bears young and regularly; fruit large and beautiful in appearance, and exquisite flavor, unequalled by any other grown; skin creamy white with red cheek, sometimes colored over the entire surface; classed as a freestone, but is not strictly so, clinging slightly, but the stone is easily removed; cut the peach with the suture, hold the peach firmly in one hand and give a half turn with the other, when it parts freely from stone; then run around the stone with the point of a knife and the stone can be thrown out. This peach is a favorite with all lovers of good fruit. It is an excellent canner, retaining its high flavor indefinitely. It should be planted in every orchard; somewhat subject to rot in unfavorable seasons, and under neglect; ripens in latitude 40 from middle until latter end of August.

CHAIR'S CHOICE.

Originated in Maryland. Tree a very strong grower and claimed by some to be a heavy bearer; with me it is slow coming into bearing and produces light crops. The fruit is of very large size; yellow with a red cheek; flesh yellow, firm, and of good quality; more troubled with curculio than some other varieties. It has never been profitable with me. Ripens here about the middle of September.

CAPTAIN EDE. N. C. TYPE.

Parentage unknown; originated in 1870 by Captain Henry Ede, Cobden, Ill., where it is very popular, ripening a few days before Elberta. The tree is a very strong grower, a very early and an enormous bearer of the most uniform medium sized peaches, always fair and smooth; no culls; matures its fruit in a short time; color lemon yellow with red cheek; perfect freestone; flavor sub-acid with slight almond flavor; quality very good, one of the finest canning peaches grown; should be planted in every orchard; it is a money maker.

CRAWFORDS.

Early or late are not profitable with me. They, like many others, have made way for newer and better varieties.

ELBERTA. N. C. TYPE.

Seedling of Chinese cling; originated with Samuel H. Rumph, Marshallville, Ga. The Elberta is certainly the most widely planted variety, commercially and otherwise, of any variety. Its leading features are its general adaptability to a wide range of territory, vigor and hardiness of tree and bud, prolific bearing, large size, highly

colored fruit of splendid shipping and market qualities, but not of highest quality. Oblong flattened, in the north; round, abruptly conic, in the south; bright lemon-yellow, splashed, marbled and often indistinctly striped on one side; dots red; thinly pubescent; skin thick, velvety; flesh yellow, red at pit, firm, juicy, tender; stone free; tree very vigorous, open, spreading, prolific; flowers small. At the Paragon Fruit Farm the Elberta has in the past been a somewhat shy bearer, but this season, 1906, it has done very well, but not on a par with Captain Ede.

FOX SEEDLING.

This is a very valuable peach, ripening at a time that makes it desirable, being the latter part of September. The tree is a strong, healthy grower, an early and abundant bearer of beautiful, large peaches; skin white with red cheeks; flesh melting and sweet; a desirable sort for canning or market; freestone. This variety has always proven profitable.

FITZGERALD.

A very fine peach of fine quality, ripening just before Elberta; not quite so large, but much better quality; suitable for home market; rather tender for shipping; flesh rich, deep golden yellow, with high character; would not advise planting commercially.

FRANCIS.

A beautiful shade of yellow, covered almost entirely with brilliant red. In size it is like Elberta, average specimens averaging nine inches in circumference; it is very productive; a perfect freestone, with particularly solid flesh and is an excellent shipper.

GREENSBORO. N. C. TYPE.

Originated at Greensboro, N. C. The Greensboro is one of the most valuable of the extra early peaches that has been tested. It ripens after Sneed and Victor and before Carman. Comparatively free from rot and is large and well colored. The tree is a strong grower, a prolific bearer and very hardy in bud; suitable for home markets, being too delicate for distant shipment. It must be watched and picked at the proper time, when the apex is beginning to soften, which happens before the rest of the peach ripens; if left until entirely ripe it shows finger marks and bruises at every point of contact.

Fruit oblong, size medium to large; cavity small, round, abrupt, greenish yellow; suture indistinct; color creamy white, splashed and striped with bright, light red; short pubescence; skin rather tender, separates easily; flesh white, tender, juicy, soft, semi-cling; tree is

broad, spreading, vigorous, productive; flowers large, making a beautiful appearance when in full bloom.

HILEY. (EARLY BELLE) N. C. TYPE.

Seedling of Belle of Georgia; originated in 1886 with Eugene Hiley, Marshallville, Ga., supposed to be a cross between the Alexander and Belle of Georgia. This peach is one of the most beautiful of the Chinese cling group. It ripens about five days ahead of the Mountain Rose, but continues ripening for some time, requiring several pickings. It is one of the very best shippers, being highly colored while still solid; it can be picked and shipped long distances and arrive in good condition. It is the first good early freestone we have. It has not been so extensively tested as some varieties, but where tested its behavior has been good and has high commercial value.

The tree is not as rampant a grower as the Carman and some other varieties, yet it makes a large spreading, open headed tree; comes into early bearing and is a regular but not prolific bearer. Fruit conical, slightly compressed, medium to large; suture very distinct; color a rich red in sun over a delicate cream white underground, where fully exposed becomes red over entire surface; dots numerous, small red; slightly pupescent; skin medium firm, separating, often breaking; flavor rich sub-acid; quality excellent; ripening at Paragon Fruit Farm from August 10th to August 18th, coming about five days after Carman.

MATTHEWS BEAUTY.

Supposed to be a cross between the Elberta and Smock, showing the parentage of both; size large to very large at the Paragon Fruit Farm, many specimens weighed 9 to 10 ounces each; fifty or less filling a 16-quart basket; claimed to ripen three weeks later than Elberta, but such is not the case here, as they ripen before the Elberta are gone.

The tree is a very strong, rampant grower, requiring hard pruning and thinning of limbs; not a heavy bearer before the fourth or fifth year. With me this season trees four and one-half years old were a sight to behold—limbs bending until the tops rested on the ground, bearing hundreds of baskets of the most beautiful colored fruit the size of goose eggs. The skin is a golden yellow streaked with red, often covered on the exposed side; flesh firm and of excellent quality; a perfect freestone. This variety sold for higher prices than any variety owing to its immense size and great beauty, bringing from $2.00 to $3.00 per half-bushel basket.

MOUNTAIN ROSE.

This is an old variety that once held the position of honor as the best second early peach, and even at the present time is planted to considerable extent throughout the country, being recommended by most nurserymen. It is a very good peach for home markets, but it is always with a sigh of relief that we pick the last basket; they must be picked while very firm, for if left to ripen they become so soft they cannot be shipped. I would not advise planting commercially. The tree is a moderate grower, a good bearer of medium-sized fruit, often very irregular in size; roundish; skin white, nearly or quite covered with red; flesh white, often stained red, juicy and sweet; parts freely from the stone; ripens between Hiley and Champion.

OLD MIXEN FREE.

This is another old variety that has gained a reputation in the past and now rests on its laurels. It was at one time one of the leading commercial varieties, but has now been superseded by newer claimants for public favor. Tree is a good grower, a heavy bearer, doing well in all localities. The fruit is medium in size; skin yellowish white with a red cheek; flesh white, but red at the stone; must be thinned or it is likely to run smaller than the market demands at the present time; quality very good, being tender and rich, a perfect freestone; ripens with Champion.

SLAPPY.

Not yet sufficiently tested to be safely recommended, but is claiming the honor of being the earliest variety in existence. Being a yellow freestone peach of large size, excellent flavor, splendid keeping qualities, free from excessive rot, ripening thoroughly to the stone, sweet yellow flesh. If it embodies all these good qualities in the different localities where planted, it will indeed be valuable. I have planted lightly, but it is not yet in bearing. The trees have made good growth; this is the second summer and the twigs have a fair showing of buds; worthy of trial by every planter.

SNEED. N. C. TYPE.

Parentage undetermined, but is said to be a seedling of the Family Favorite; originated by Hon. J. S. F. Sneed, Nashville, Tenn. This variety has been grown under the name of Peebles in Mississippi, and under the name of Bowen in Arkansas. The tree is remarkable for its thrifty, low spreading growth; leaves large, broad, rich in color; can be distinguished from any other variety even at a distance.

It is an enormous bearer and unless thinned overbears, when the fruit remains small and lacks flavor. Its extreme earliness makes it valuable. Fruit round, oblong; suture indistinct, depressed slightly at the apex and cavity; color greenish white overlaid with a bright lively red (trees must be kept open or it will have little color); dots small, pink; bloom slight; skin rather delicate; flesh greenish white, red under the sunny side, juicy; stone cling; quality poor. This variety has proven the earliest of any with me; we have commenced picking the Sneed peaches on the 4th or 5th of July for several years. I would not recommend the peach commercially, unless close to the market and the best of care given; but a few trees are profitable.

STUMP.

This is also an old, well known and well tried variety, and has given satisfaction generally. The tree is strong, spreading, a good though not a heavy bearer; when well grown the fruit is large, roundish; skin white, with a bright red cheek; flesh white, juicy and highly flavored; freestone. It has always stood as one of the best market varieties, but I have discontinued planting it for a number of years, it never having proved as profitable as some others. Perhaps I expect too much; if a variety does not average at least from one peck to half a bushel at two and one-half years, and two baskets at three and one-half years, and from four to five baskets in the fifth year, I think it has not done its duty and it gets put on the retired list.

STEPHENS.

This is one of the productive late peaches that can be planted profitably in every orchard; it comes in when large white peaches are scarce and brings good prices. The tree is a strong, vigorous, upright grower, not a heavy bearer when young, but about the fifth year it gets in its work, producing large crops of fine, large white peaches, shaded and mottled with red; a perfect freestone; quality excellent; a good commercial variety.

THURBER. N. C. TYPE.

Seedling of Lee; originated with Dr. E. L. Berkmans, Augusta, Ga. The fruit is round conic, enlarged at center along suture; size medium, averaging about 2 inches in diameter; color creamy white, thinly covered with light crimson on sunny side; sometimes indistinctly striped; dots, small, red; bloom white; skin thin but firm, separates easily; flesh white, red at stone, juicy, melting; flavor subacid, vinous; quality excellent; season just before the Belle of Georgia; flowers large; tree vigorous; a good commercial variety; a great bearer, fruit always a good size; a splendid shipper and good keeper, classed among the money makers.

VICTOR. N. C.

Parentage undetermined; originated with John B. Bass, Bass, Texas. Fruit roundish; size medium; pubescent; suture deep at cavity, medium deep at apex; color creamy white with slight blush. At Paragon Fruit Farm, when fully ripe, it becomes red over the entire surface; dots small; down short; skin medium thick; flesh creamy white, sometimes tinted red, melting, juicy; flavor sub-acid, with slight almond flavor; quality good, ripens with Sneed, but far surpasses it in quality. I consider this the best early peach grown. Comparatively free from rot. Semi-cling.

WADDELL. N. C. TYPE.

Chance seedling; originated with Wm. Waddell, Griffin, Ga. An early variety, coming in a few days before Carmen; it is very productive, must be thinned, or it overbears; size medium; fruit oblong, creamy white, stained bright red cheek in sun; dots abundant, red; bloom slight; skin thick; flesh white, stained, juicy, tender; quality good; semi-cling; tree not a strong grower but spreading.

NIAGARA.

This variety is called the new Elberta by some, since it closely resembles it, possessing all the good qualities and none of the defects of that peach. It averages larger, of better quality, ripens one week earlier, bears heavier, and in every way better. There are many other varieties not given here, that possess good qualities and are very productive in many localities, but out of the many I have endeavored to select a few I consider best; and even this list is much too lengthy for the commercial orchard, where six or eight varieties at most are enough, and if properly selected, will follow each other, filling the season profitably.

PEACHES FOR HOME AND MARKET.

In the production of this luscious fruit there are more failures than in any other. Questions are being continually asked relative to varieties, soil and locations suitable for their culture, the planting, pruning, and culture, spraying for insects and fungi. It is my purpose here in this bulletin not only to give as I have, varieties that have done well in suitable places in Pennsylvania, but to curtail this list to suit most occasions, and to present in easily available form the A. B. C. principles of peach culture which seems ever to be demanded by the planters of our State.

There are, of course, certain unfavorable locations where it would be fallacy to attempt to produce peaches of even the most hardy varieties. But I do not believe there are any large areas of territory within the boundaries of our State that have not favored locations where the most hardy varieties will thrive. In latitude 40 and

sections lying farther north, in sections of the State in which rigorous and erratic climatic conditions prevail, the following may be selected: Greensboro, Carmen, Belle of Georgia, Capt. Ede, and Iron Mountain, (the latter variety is a large late white peach, very hardy in tree and bud. My friend W. H. Stout, of Pinegrove, Schuylkill County, Pa., places this peach at the head of the list in his vicinity, being productive when other varieties fail). This list is short, but it comprises the cream of the list in hardiness, and good quality, and they cover the season from early August until October. Let the beginner in unfavorable sections confine himself to this prescribed list commercially, and test other varieties until he is satisfied they are suitable for his locality.

SOIL.

The peach is not especially exacting as to soil. It is generally conceded that it does best in ground of a sandy character, though it will thrive and produce fruit of the highest quality on stiff, well drained clay. But it is of the highest importance that it be well drained either naturally or artificially. No fruiting tree will do well with its roots imbedded in cold water-logged earth. The soil should be fertile, with sufficient humus but not too rich nitrogen, but an ample supply of available phosphoric acid and potash.

LOCATION.

All things considered, a cool northern or northwestern slope is to be preferred; such exposures retard bud development in late winter and early spring, tiding them over the danger from late spring frosts, which are so destructive where trees are forced into bloom prematurely. Light sandy loams upon warm sunny southern or eastern slopes should be avoided. A western slope is preferable to a southern one. This matter of exposure pertains really more to very steep high hillsides, where there may be a marked difference; but on ordinary sloping hillsides as we have them in the southeastern portion of the State, the variation of exposure is not great. On the Paragon Fruit Farm, as has been mentioned elsewhere, we have every exposure, and have had no failure of a crop from freezing or other causes, in thirty-five or more years. More danger lies in lack of knowledge and application of proper culture and fertilizing than aught else. But the hillsides have the preference, because they afford natural drainage of both water and air, both of which are essential to profitable crops.

PREPARATION OF THE SOIL.

This subject has been so fully treated elsewhere, that it would be a waste of time to go into detail again. But here we tread on dan-

gerous ground, without wishing to condemn any practice that has given partial success to many planters. I must draw the line on methods of getting and maintaining fertility in the soil for the peach. I know the majority of fruit growers will disagree with me, but in some instances the minority can be right, and without entering into the scientific reasons, (I will leave that for the scientists), I will state that when for some reason there is an occasional failure of a crop, we must come to the natural conclusion that there is something wrong, that something has been done that should not have been done, or that something has been left undone that should have been done. If, on the other hand, by close attention and skillful manipulation, you have obtained successive crops through a long series of years, without one single failure, does it not show that you have struck the key to success? Does it not show that you have been working in harmony with nature, that you have applied the right thing at the right time, that you have left undone that which has proven injurious to your neighbor? But your neighbor, in his endeavor to shirk responsibility, will claim that it was due to natural causes, that the ingenuity of man could not change it; that if frost comes and freezes his crop he could not stop it. This we will admit, but man can by proper intelligent methods, store up sufficient vitality in his trees, as to render them immune from the effects of freezes that would under ordinary conditions destroy them. Now our horticultural lights will tell you, if the soil is fertile to apply and plow in a heavy coat of stable manure; I tell you to prosecute the man that hauls a load of stable manure in your peach orchard. Dread it as the burnt child dreads the fire. It is death to all hopes of continued profitable crops. It contains too much nitrogen; it pushes too soft succulent a growth for the development of healthy wood and buds; it renders it incapable of withstanding the inclemency of our rigorous winters with their many changes. The tree has continued growth until winter sets in, often with leaves unshed, cells gorged with immature sap, the continued freezing ruptures these cells, the vitality of the tree is impaired, leaving it in the spring in a weak sickly condition, a fit subject for the attack of fungus or bacterial germs; the tree lingers a few years and dies without having given any profit for labor or money expended.

But the soil must have humus. How shall we get it? This I admit, humus in reasonable amounts is necessary, but I would rather bank on success in a soil deficient in humus, than on a soil with a surplus of nitrogen. I have never seen the soil so devoid of humus that I could not raise peaches by continual culture. Attrition will render the soil loose, porous, and retentive by the application of fertilizers in an inorganic form, and I can raise maximum crops, but if there is a surplus of nitrogen the damage will be done before the soil can be-

subjugated. I do not condemn humus, I want it, but I will get it by means of green crops, plowed under; these will give me humus in a better form than stable manure, and with a much smaller proportion of nitrogen. I have occupied considerable space to this subject; its importance is my only excuse. The preparation of the soil is the same as for the apple, and my method of planting is given in article on laying out the orchard. Should the ground be too steep or stony to plow, then larger holes should be dug and the surface mulched with grass, weeds, or any mulching material that will aid in retaining moisture, etc.

AGE OF TREES.

One year is the limit, strong, healthy trees, 4 to 6 ft. Do not be tempted to take small stock, June buds, etc., at any price. The best is none too good, it is the foundation of your future hopes. This subject has also been treated in another place.

PRUNING.

A low headed peach tree has many advantages over one that is higher, as it has the natural tendency of the peach to rapidly gain height; for this tree, not bearing on fruit spurs as the apple and pear, but always on new wood of the previous season's growth, the tree naturally, unless it is judiciously pruned, soon gets tall, and the fruit is borne far from the stem. It is only by low heading, constant annual pruning, that the tree can be kept in proper shape. All strangers visiting the Paragon orchards, are astonished at the extreme low heads on all the trees. Trees coming five years old have a top diameter of 15 feet or more, with the lower limbs starting not over one foot from the ground, and running out horizontally, with their tips touching the ground, instead of vertically, as we seem them in other orchards. These lower limbs, after having produced three good crops during their short existence, are still in prime bearing condition, not only on their terminal growth but new wood is being annually produced on their entire length. So it is with the rest of the tree, instead of being two or three stories high, all the fruit can be picked from the highest limbs, from a five-foot step-ladder; nine-tenths of the entire crop can be picked while standing on the ground. Fully one-third of the crop is borne on limbs that rest their ends on the ground. Many people argue that fruit borne on these bottom limbs will not mature, will lack color and flavor, but this is a mistaken idea. The fruit on these lower and inside limbs acquires a finer color and higher flavor than most peach orchards under different management produce on the upper limbs. This entire orchard is a model of beauty; trees low, spreading, symmetrical in shape, with open heads; fruit borne in the center, as well as on the

outside of the trees; there is no part of the tree in which the fruit does not at some time in the day get air and sunshine sufficient to prevent the development of fungi, and at the same time develop and mature the fruit to the highest state of perfection. But before giving my method I will give my reasons for pruning. 1st. Pruning is not devitalizing unless it is carried to excess. Removing parts of the trees improves the condition of the parts remaining by distributing more nourishment to the remaining parts. There is always a struggle in nature, and the weak must succumb to the strong; without pruning the limbs having the best positions thrive at the expense

A B

Fig. 57. A. Tree with one summer's growth unpruned. B. Shows the same tree pruned. This is the method to prune for high top trees.

of the others. This can be avoided by proper pruning and any desired form given.

Pruning should be done annually, as if left, large limbs must be removed to the detriment of the tree in form and health. By judicious pruning a tree may be kept in bearing condition indefinitely as it gives it fresh vigor and forms bearing wood nearer the source of nourishment. By reducing the struggle for existence among the limbs, the fruit is larger, always colored, and of better quality

Fig. 58. Badly formed tree with a crotch liable to split. But by removing the part of the tree at a, a new head is started which will make a good top with five foundation limbs.

This is the style of pruning adopted at the Paragon Fruit Farm.

A B C

Fig. 59. A. Represents a one year tree pruned to a stub 12 inches high. B. The same tree after one season's growth, the marks show where to cut back. C. Same tree at end of second year. This season these trees should bear one basket per tree.

Heading in the stronger shoots tends to throw the weaker ones into fruiting. Heavy pruning tends to produce top, as the root energy remains the same.

ROOT PRUNING.

Was treated under another head, where the results of different methods were given. It was there shown that roots pruned to three inches gave the best results. At the Paragon Fruit Farm all peach roots are pruned to about five inches, all bruised and torn portions are removed, cutting all diagonal roots, sloping, so that the cut surface will set flat on the ground. If the tap root is too long it also is cut back proportionally. These trees are then set about one inch deeper than they stood in the nursery row. The tops are pruned before or immediately after planting; all side limbs removed and the stem cut down to about twelve inches, leaving a mere stub. (See fig. 59). I prefer a medium tree, as there are no large limbs, but plenty of dormant buds on the stub to form a fine top. The shoots coming from these buds give the foundation upon which we build. Very little if any pruning is required the first season. but then early the following spring is the time to select the foundation branches, four or five of which, coming from different points of the stem should be left to form a symmetrical top. All others should be removed, and the foundation limbs be cut back, from one-half to two-thirds according to the vigor. (Never leave these foundation limbs in such position that they form a crotch which is liable to split and ruin the tree). (Fig. 58).

This is illustrated in Plate 57. A represents a tree having made one summer's growth. B represents the same tree pruned. It will be noted that there are five well placed foundation branches; as these trees are exceedingly vigorous they will require some thinning cut in the summer; with less vigorous trees but little thinning will be required.

SECOND YEAR'S PRUNING.

Ordinarily I do not prune back a head the second year. Thin out the branches that crowd and cross each other, making all cuts close to the trunk we have now a splendid foundation. If the growth is strong from one-third to one-half is removed at this pruning, cutting off immediately above an outside bud or small limb. By this method of pruning I keep the heads low and spreading. (Fig 60). A represents tree unpruned; B after pruning. These trees are only the second year's growth.

AFTER SECOND YEAR.

The pruning after the second year is practically the same, annually pruning out all surplus branches; then head the leading

cnes back one-half or more of their growth, making the cut just above a secondary branch or a live bud; by this means most of the bearing twigs will remain on the tree. Many of these will have to be taken out or the tree will become too thick for best results. These side branches I prune back but little, just enough to cause them to send out more lateral bearing wood along the entire length of the limbs. Some growers get into the mistaken idea that all twigs must be cut off clean excepting a bush on tip of each top; they

Fig. 60. A. Shows a tree two year's old, unpruned. B. Shows same tree pruned. These are for high top trees.

endeavor to prove their skill by the amount of brush they can cut from it. Specimens of this kind are seen in plenty in passing through the country. long bare limbs, six or more feet from the ground, shorn of their usefulness and beauty, and left to blush at the exposure of their naked limbs. All bottom limbs are removed under the mistaken idea, it is necessary for the successful cultivation of the soil, and the productiveness of the tree. Such trees may be brought again into profit by

GROWING A NEW HEAD.

If the trunk and limbs are healthy a new head may be grown by cutting off the limbs to stubs, from two to three feet, depending upon the age of the tree and their position—the younger the tree the shorter the stubs. A most luxuriant growth will be forced out from these stubs, which, with proper pruning, will again make good low headed productive trees, from which the fruit can for many years be picked while standing on the ground. I will guarantee there is not another orchard in the State as broad headed and low topped as the Paragon Orchard. I feel also that the majority of horticulturists will tell you my method is wrong, that the bottom limbs should be cut away to make cultivation easier and produce finer fruit. That my method is right is proven by results.

Few orchards in Pennsylvania or any other state show a record equal to this. I obtain more fine fruit from the bottom limbs than one-half of the best orchards get from their entire trees. This orchard was planted in the spring of 1902. In the summer of 1904, or two and one-half years of age, this orchard of six acres averaged one sixteen quart basket per tree. In the summer of 1905 it averaged three baskets per tree, and this season, 1906, it averaged four baskets per tree, making an average of eight baskets per tree for the three years, or a grand total of eight thousand baskets, which have averaged one dollar per basket. The trees are now in the best of condition with rich dark green foliage having made a good sturdy growth all over and through the tree, and are heavily set with good strong buds for next season's crop. If my method is wrong, why is it I have constantly increasing crops of fruit of the highest quality? If my method is right, as I am convinced it is, then why should I change it?

My method of pruning is, start low, prune to outside buds to spread tops, shorten in tops, let laterals grow, keep heads open, by pruning when required, in spring or any time during the summer. You need not fear to use the knife judiciously at any season. I had one man at work constantly for two months during midsummer, removing all surplus wood and fruit on this six acre plot, and they responded generously to this kind of treatment. Next season will require at least two men during the entire season pruning out surplus limbs.

CULTURE.

Many think it impossible to keep up clean culture where trees are standing with limbs coming together and resting on the ground, but it is all in the knowing how. The first year after the trees are planted, the ground is harrowed and put in good condition and five hundred pounds of high grade fertilizer analyzing four per

cent. of nitrogen, six or eight per cent. of phosphoric acid, and ten to twelve per cent. actual potash is spread broadcast and harrowed in; four rows of early potatoes are then planted in each space between the rows of trees, applying another five hundred pounds of the same grade fertilizer in the drill before planting. The potatoes are harrowed not less than twice a week as long as the potatoes permit. As soon as potatoes are matured they are dug, the ground is well harrowed and cow-peas are drilled in, two bushels per acre; these make a fine heavy growth; they are left as a mulch over winter. In the spring they are plowed under, the ground is then harrowed several times crosswise with a spring-tooth harrow to loosen the space not plowed, and to level the ridges and gutters made by plowing. Potatoes are again planted with the same amount of fertilizer, they are given the same treatment as the first year, cow-peas again sowed, or if I think the soil rich enough in nitrogen, then I sow oats; again let lie as a winter mulch. The third summer, the trees are now large enough to require all the ground, as we expect a crop of fruit, so we apply only phosphoric acid and potash and cultivate from two to four times a week with spring-tooth and drag harrow. Some may think this requires too much labor and expense; if you cannot give time and money, then do not go into the peach business, or you will make a failure. This season the baby crop should amply repay you for all money spent for land, trees, fertilizer, labor, etc., and give a fair surplus. This cultivation should be kept up until not later than the middle of July. This season we put in no clover crop. The following spring and summer, it gets the same generous treatment, and so on year after year. The question here arises, how can we cultivate with limbs meeting and tips on the ground? Early in spring before the ground settles take the spring-tooth harrow, divide the two sections and put a broad steel frame between this; this spreads the harrows that the team can walk between the rows and the harrow creeps under the limbs close to the trees. Have the blacksmith bend the levers so they will lie horizontally, and slip under low limbs; go thus around each row one way, then harrow around each row cross-wise; after this remove the frame, join the sections, and harrow the middles, by this time your soil is in excellent condition. After this we use a three section drag, we have these cut the proper width that once going through, harrows the entire width; we harrow alternately each direction; never let a crust form, harrow after each rain as soon as the soil is in condition; keep a dust mulch constantly; the drier the weather the more you harrow, and the more moisture you keep in the ground, and your trees and fruit will never be checked by drought, and your reward will be manifold.

THINNING

Is more essential in the peach than any other fruit. There are two methods adopted by the orchardist, one by pruning, the other by hand picking. Approximately the same results may be had by either method, but more judgment must be exercised when thinning is done by pruning than when the fruit is taken off by hand. It requires some practice to enable one to thin by pruning, and no rule can be set down as to the number of buds to removed. Nevertheless it is best to prune peach trees with a view of reducing the number of fruits, thus increasing the size, without reducing the number of bushels. The young twigs of last season's growth need to be cut back in order to keep the tree within bounds. If the buds are nearly all alive, fully one-half, and in some varieties three-fourths of all the buds can be removed; should it be discovered later in the season that the tree still has too much fruit, it can be further reduced by hand picking. In fact I always prefer hand picking, as many small growths have two or three peaches close together, and as the fruit grows they come in contact, whereas each specimen to acquire the best size, color, etc., should stand separate; this can be done only by hand picking; for best results no two specimens should be closer than five or six inches; we can make this a standard, then come as near to it as circumstances allow. Thinning should be done in early summer when the fruit is the size of cherries or before the kernels begin to harden. It is the seed developing process that exhausts the tree of its vitality. But should early thinning be neglected, later thinning, even when the fruit is two-thirds grown, will benefit both tree and fruit. A combination of the two methods is well adopted at the Paragon Orchards.

ENEMIES OF THE PEACH.

These are many and the successful peach raiser knows by sad experience that eternal vigilence is the price of success; and many times he almost despairs when he sees the formidable array of foes to combat.

PEACH BORER.

A slender blue moth resembling a wasp. The eggs are laid on the tree near the ground; the young larva work for a time on the bark before penetrating, but as they grow they bore through the outer bark to the cambium, upon which and the soft inner bark they feed, tunneling in different directions; their presence can always be detected by the exudation of sap or gum, and is interspersed with sawdust-like excrement. It is in the larva state that it injures the

trees; often when several are in a small tree they eat around the entire tree and then kill it. The insect passes the summer months in the larva form, which when full grown measures over three-fourths inch in length, and nearly one-fourth an inch in diameter; it is a naked cylindrical grub, of a pale whitish yellow color, with a reddish horny looking head and black jaws; when about to become a pupa, the larva crawls upward to the surface of the ground, and constructs a pod like case of leathery structure, made of its castings mixed with gum and threads of silk. It is about three-fourths of an inch long, of a brown color, oval in form. It is fastened against the side of the trunk or root beneath the surface, with its upper end protruding slightly above. It passes the winter in either the larva or pupa state; the moth appears from the latter part of June until the middle of July, later further north.

Remedies.—Many washes are recommended but none of them can be relied upon. Hot water poured around the tree will destroy them; it must be used very hot, after the earth has been removed, so as to reach the larva. The method adopted in the Paragon Orchard is to throw the earth in a mound about six inches high around the tree; leave this all summer; when the moth lays her eggs, they are thus laid higher up on the stem just above the ground; the young larva thus eats at the bark of the trunk, instead of being among the roots; at the approach of cold weather these mounds are removed. and the larva and their work is brought into plain view; being above the ordinary level. they are much easier to destroy than if they were deeper down; this is left open, and in a couple of weeks the trees again looked over, and those missed in the first examination are dug out and destroyed; after which another mound is thrown up to remain until the following season. The knife or wire is the only sure remedy.

YELLOWS.

This is one of the most common diseases of the peach, and has done more damage, and destroyed more trees, than all other diseases combined. The first symptom is the premature ripening of the fruit on one or more limbs; the ripened fruit shows conspicuous red spots from skin to pit; new buds develop along the branches and trunk, and tufts of fine shoots are conspicuous, scattered along the main branches; later the foliage becomes yellow, but this yellow is not a sure sign, as it may be from other causes, such as from the effects of worms, poverty of soil, or where weeds and grass occupy the ground and often starve the tree. As to remedies, there are none known; the best is, as soon as the fruit symptoms are noticed, pull out the tree and burn to prevent spreading.

Rosette, and Little Peach, are two serious diseases in many sec-

tions, the former in the south, and the latter in Michigan. There is no remedy, but to cut and burn.

SAN JOSÉ SCALE.

This insect, treated of elsewhere, is specially injurious to the peach; killing the tree in one or two years if neglected. This insect is treated fully in another place.

CURL LEAF.

This disease is variously known in different regions. In the U. S., it is known as peach leaf curl. Leaf curl is a disease which seriously affects the leaves, flowers, tender shoots, and fruit of the peach. Its action is most severe in the spring of the year, shortly after the leafing of the trees, and the greatest injuries are caused in wet seasons and in humid localities. The leaves become enlarged, thickened, much curled, much distorted. As the disease progresses, the healthful green foliage is changed to a yellowish, sickly appearance; the leaves soon fall, and the newly formed fruit ceases to grow, gets yellow, wilts and drops. The total loss of foliage is common in seasons favorable to the disease. A second growth of leaves develop, more or less rapidly, according to the severity of the disease, and the favorable or unfavorable condition of the soil and atmospheric conditions prevailing at the time. If the soil and atmosphere are dry, and the temperature is high, new foliage appears slowly, and much of the terminal growth may die. In severe attacks young trees are frequently killed. The second crop of foliage usually remains free from the disease for the rest of the season, depending largely upon the humidity or dryness of the atmosphere; excessive humidity favoring a continuance of the trouble. The action of the disease upon the spring branches causes them to enlarge, become curved and distended, and often dry up and die.

The origin of the disease is not definitely known, but indications point that the home of the peach is the source of the disease, and that the two may have come to us together from a common point of origin; and as the large proportion of our types of peach come from China, it is natural to suppose China is its home.

LOSSES FROM THE DISEASE.

The direct annual loss to the peach interests from peach leaf curl is very large, and is usually much larger than is suspected by the growers themselves, as the nature and action of the disease are misunderstood by them, and their effects frequently attributed to other causes. In case curl occurs after a severe cold spell in spring, as is quite commonly the case, the orchardist is apt to charge the loss of fruit to the low temperature rather than to the disease.

NATURE OF PEACH LEAF CURL.

The direct cause of this disease has been long known as a parasitic fungus. But it is evident that the injurious development of the fungus is distinctly correlated with special physiological phenomena of the peach tree itself. These conditions of the tree are in turn dependent upon such external influences as temperature, humidity of soil and atmosphere, and others. Many growers consider the disease as the direct result of excessive moisture and low temperature or sudden changes, and it is certain they have a strong bearing upon the injurious development of the disease, and may be considered together with the direct relations of the parasite with its host. However, too much stress cannot be laid upon the fact that the fungus alone is responsible for the injury to the tree. Without the parasite not a leaf would curl, or a peach fall on account of this malady, in fact no such disease would exist. It is fortunate that the direct cause is a parasitic fungus rather than unfavorable atmospheric conditions, for the latter could not be controlled while the control of the fungus is not only practicable, but simple and inexpensive.

TREATMENT.

As in all fungus diseases, the treatment is more largely preventive than curative. At least two modes of infection of the peach tree are said to exist (1) by means of perennial mycelium, (2) by means of the spores of the fungus. It is claimed that the mycelium winters over in the youngest portions of the one year old branches, and with the beginning of the new season's growth the mycelium extends into the leaves of the young shoots. The second mode of infection—that by means of the spores—is probably much more general and important in this disease than has been supposed. That 90 to 98 per cent. of the infections of the tree are prevented by a single spraying, suggests that at least that percentage of the infection is by means of spores. All but two or three per cent. of infections have been prevented by a single spraying. That such spraying did not prevent the spread of mycelium in the inner tissue of the host is shown by the results of experiments, that when it is delayed until the leaves have fairly started, and have become infested, the treatment is ineffective and the disease will continue to develop and both foliage and crop may be lost. It is not the checking of the spread of the mycelium from the branch to the new leaves, therefore, that results from spraying, but the prevention of the early spore infections from without; and as all but two or three per cent. of the year's infections may be thus prevented, all of such infections must be considered as arriving from spores. The successful treatment of peach leaf curl dates from the time when fungicides were first

applied to dormant peach trees. This treatment was first applied in California, being introduced by the winter application of sprays for the destruction of the San José Scale. This insect was introduced about 1870; but some time elapsed between the date of its introduction and the use of the stronger winter sprays for its control. Various sprays were used, but it was not until the sulphur and lime, or a sulphide of calcium was used that marked success was had in preventing peach leaf curl. It was about the year 1885 that particular notice was taken that orchards treated with lime, sulphur and salt solution, were entirely free from leaf curl, while orchards not treated were so badly affected that all the foliage fell off.

COPPER SALTS FOR LEAF CURL.

About the year 1889, the copper salts, as Bordeaux mixture and ammoniacal copper carbonate were successfully used; trees sprayed in January and February with Bordeaux mixture, were healthy, well set with fruit and dark green foliage, and no curled leaves; while on the other side of the fence, where no spraying had been done, peach trees were very badly attacked with leaf curl. One peach tree had been sprayed only on one side with Bordeaux mixture, and on this side the foliage was clean and healthy, while on the unsprayed side it was curled.

Our experience at the Paragon Fruit Farm is, that whenever our peach orchards are sprayed with lime and sulphur solution while trees were dormant,(best before buds begin swelling), we have never had any leaf curl. In the spring of 1905, inclement weather prevented us from spraying our entire peach orchard; some trees were sprayed over the entire tree, these were entirely free from curl; part of the orchard was sprayed on one side only, with lime and sulphur, the wind being too strong to spray the other side before the buds swelled; after buds were well swollen, part of these trees were sprayed on the opposite side with Bordeaux mixture, and part left without any spraying, with the following results; The side sprayed with lime and sulphur were free from scale; the side sprayed with Bordeux mixture had about 10 per cent. of curl; the trees and parts of trees left unsprayed were so badly infested that they lost all of their foliage and a large proportion of their fruit. I have never had an instance of leaf curl that did damage, when sprayed while trees were dormant, both lime and sulphur being effectual. But I use lime and sulphur in preference, as it answers two purposes, that of destroying the San José Scale and preventing peach leaf curl; I say preventing, because I do not believe the disease can be cured when once the spores are established, at least this is my experience. If Bordeaux mixture is to be used, while trees are dormant, use formula No. 1, 6 pounds copper sulphate, 4 pounds lime, 50 gallons water.

If for any purpose Bordeaux is to be used on peach after the tree is in foliage, then formula No. 3, should be used, 2 pounds copper sulphate, 6 pounds lime, 50 gallons water. The peach is very sensative and formula No. 1 or No. 2, will cause foliage to drop.

MILDEW OF THE PEACH.

Peach mildew is widely distributed; the fungus causing it attacks the leaves, fruit, and tender branches in the early part of summer. The branches serve for the wintering over of the spores, thus aiding in supplying the source of spring infection. Winter treatment of the tree with either the copper or sulphate sprays, will largely limit this spring infection, but later treatment with weak sprays, will be necessary for full control.

BLACK SPOT OF THE PEACH.

The disease which produces the black spot of the peach is quite common in our Pennsylvania orchards; when the fruit gets about three-fourths grown these spots appear on the upper surface of the peach, and if badly infested this side ceases to develop, becomes wilted and the fruit either drops off, or fails to fully develop. The spores of this fungus doubtless winter upon the tree, and can be controlled by some of the winter sprays. I have been little troubled since using the lime and sulphur mixture. If it appears, spraying while in its first stage with weak copper sprays will hold it in check.

BROWN ROT.

Brown rot of the peach has become one of the most destructive fungus diseases we have to combat. It is quite general throughout Pennsylvania wherever the peach is raised. If the atmospheric conditions are favorable for its development it often destroys all the early, and frequently a large proportion of the late crop. The fungus winters over in the diseased branches and the mummified fruit that remains hanging on the trees over winter. It seldom attacks the fruit until it has attained nearly its full size, and is beginning to ripen. Its attacks are often sudden; the prospects may indicate a fine picking in a few days, but often inside of forty-eight hours the larger proportion of the fruit will be more or less rotten. Even this disease is greatly reduced by winter and spring spraying. Since I have been using sulphur washes, and properly thinning out my trees and fruit, I have had very little trouble; even early varieties, that are very subject to rot, have ripened to perfection.

SOOTY MOLD OF THE PEACH.

When the fungus is present, the bark of the trunk, and inner limbs become covered with a sooty mold, giving the bark a black appear-

ance; it later in the season, covers the foliage and fruit, interfering with the health of the tree and the development of the fruit, rendering it unsightly.

Where winter spraying is done, very little if any is found; orchards affected with it, should be sprayed while trees are dormant, with lime and sulphur solution, or No. 1, Bordeaux mixture.

WINTER KILLING OF TREES.

In many localities where proper care was not taken in the selection of a site, and the after care not what it should have been, the peach often suffers severely; not only the buds, but the terminals and sometimes nearly the entire tree is killed; but where judicious care has been taken to fill all the natural requirements of the peach, it is very seldom indeed that even buds are injured, unless it be beyond the natural zone in which the peach thrives, where the thermometer registers from thirty to forty degrees below zero, there can be no precaution taken that will insure the safety of buds or wood. But by observing the few rules given below, the peach can be grown and bears fine fruit in two out of every three years in many locations now considered too far north, and the winters too severe. Indeed there is more assurance of success where the winters are more even, less subject to sudden changes than there is in the Southern states, where a spell of warm weather in early spring, starts the buds, followed by severe freezing weather, which almost invariably destroys them. In Florida, south of Lat. 30, where the Peen-To type of peaches are raised for the early northern markets, the growers consider themselves fortunate, if they get two good crops out of three; often they get but one.

TEN COMMANDMENTS THAT AMELIORATE CIRCUMSTANCES.

The planter who has done his work well, and intelligently carries out these rules, may feel assured of being amply rewarded; not that these rules are iron-clad, infallible. Occasionally nature's plans and ours do not harmonize; but nature's laws do not often deviate sufficiently to cause serious loss, where intelligent care and culture have been given. There are disturbances of the elements that man cannot entirely overcome. You cannot check a cyclone or a deluge. You cannot go directly contrary to nature without paying the penalty. There are zones in which certain vegetables and trees grow; there is a zone on a mountain in which evergreens thrive; we also have the alpine zone on the same mountain is above the limit of tree growth. The apple thrives, and is at its best in certain areas, with certain environments. in the north temperate and south temperate zones. The varieties of apples that do best in Pennsylvania, latitude 40, do equally well in New Zealand in the

same latitude south temperate zone. The pear and peach, the citric fruit all have their zones. So the storms, the hurricanes, the cyclones all have their zone in which they travel, with slight variations. So even these dangers may be more or less averted by having a geographical knowledge of the various locations.

1. Soil; well drained sandy loam; loose stone are no hindrance or detriment except inconvenience in cultivation. Avoid compact clay, as failure is stamped on its surface.

2. Location; select a gently sloping hillside in preference. Exposure, not material; a northern exposure may have slight preference, other things being equal. Exception; the shores of large bodies of water so influence and temper the severity of the winters, as to render them ideal sites for the peach.

3. Fertility; the land must contain all the elements necessary for the production of tree and fruit. Avoid too much nitrogenous food; have an abundance of potash and phosphoric acid in an available form.

4. Selection of varieties; upon the selection of hardy varieties producing an abundance of large, high colored, high quality fruit, depends largely the profits. For cold selections select from the North China type; see under heading of varieties.

5. Planting in properly prepared soil.

6. Pruning; start heads low, never over one foot; cut back tops; let the laterals grow; keep heads open by pruning out superfluous wood; do not cut off bottom limbs; more fruit can be raised on the ground floor than on the attic, fruit can be gathered at half the cost; low trees do not suffer from high winds.

7. Cultivation. Successful peach raising depends upon clean culture; cultivate early, cultivate often, at least from two to four times a week; stirring the soil is the key that unlocks fertility, and retains moisture; methods given at another place.

8. Thinning; the essential is maintaining healthy productive trees and choice fruit, the more you thin a heavy laden tree the better the results.

9. Spraying. The only means of controling insects and fungus diseases; know what you are spraying for; use lime and sulphur solution while trees are dormant. It acting as an insecticide and fungicide, use arsenites for masticating insects. Bordeaux mixture for fungi.

10. Marketing. This branch must be understood. If all your other work has been successful and you are incapable of handling this end, the business will not be a financial success. Gather and handle with care; grade and pack conscientiously; put your name on your packages, which must be neat; never use old, dirty packages; good goods demand good clothing and command good prices from

good customers, and create good markets, in all good communities having good tastes.

THE CHERRY.

All the cultivated varieties probably originated from two sources, both European. Prunus Avium, the ancestor of the sweet cherries, and Prunus Cerasus, the ancestral type of the sour cherries. The sweet cherries are characterized by a tall, erect growth, with glossy, reddish brown bark, which tends to peel in rings. The flowers are generally in clusters on lateral spurs, appearing with the leaves, the latter limp and gradually taper-pointed; the fruit yellow, red, or black, sweet, spherical, heart-shaped or pointed; the flesh, soft or firm.

The sour cherries differ in having a low headed and spreading form, and flowers in clusters from lateral buds, which appear in advance of the leaves, the latter hard and stiff, and light or grayish green, the point rather abrupt. Fruit rounding, red, soft and sour.

In this country the sweet cherry is represented by a naturalized, hardy, vigorous growing, wild, variety, common along our fences and the road sides, and known as the mazzard. It is a European species, and its seedlings are imported, and are also grown in this country for stocks on which the cultivated cherries are propagated.

Three cultivated types have sprung from the mazzard:

1. The Hearts, or heart-shaped, soft, sweet cherries, light or dark colored, such as the Black-Tartarian, Black Eagle, Elton, etc.

2. The Bigarreaus, or firm fleshed cherries, light or dark colored, heart-shaped, such as Yellow Spanish, Windsor, Napoleon and others.

3. The Dukes—Sour Cherries, with firm, light colored flesh, among which are the May Duke, Reine Hortense, Late Duke, etc.

From the Prunus Cerasus two types have sprung:

1. The Amarelles, or light colored sour cherry, with colorless juice, generally flattened at the ends, represented by Montmorency, Early Richmond and others.

2. The Morrellos, or dark colored sour cherries, with dark-colored juice, heart-shaped or spherical fruits, among which are the English Morello, Ostheim, Louis Phillippe and Dyehouse.

Besides the cherries already mentioned, the following species are used as stocks in propagation, or are cultivated in a limited way:

P. Mahaleb. On this type the sour varieties are mainly worked, and sometimes the sweet varieties. It is a smaller growing tree than the mazzard, less vigorous in growth, but more hardy. and better adapted to heavy lands, and with proper pruning produces dwarf trees.

P. Pennsylvanica, our common native wild red cherry, being very hardy, renders it valuable for stock to propagate other varieties upon. The P. Besseyi and P. Pumila varieties, growing wild in the mountain regions of the West, are of little value to us in Pennsylvania.

SOIL.

The cherry is not particularly choice as to soil, growing and fruiting in almost any soil that is not too low or wet. But like all other fruits it has its preference, and reaches its highest development in a naturally light, dry, loamy soil. It should be retentive of moisture, but sufficiently drained that it never "soars." The sweet cherry will thrive on loose gravelly soils that are too dry for other fruits, but sour varieties require more moisture to develop their best cherries. At the Paragon orchard I planted several rows of Montmorency as fillers between the apple trees, on a high knoll. They grow well and bore heavily as long as the apple roots did not spread too far and extract the moisture. But I note the present year, 1906, that although the trees had an enormous crop, as is represented in Fig. 46, which shows a nine year old Montmorency tree so heavily loaded that its limbs reach near the ground, yet I find they suffer for want of sufficient moisture, and the fruit is not quite so large. The trees make annually less growth, drop their foliage earlier, and show a general lack of thrift. Trees that are not encroached upon by the apple, having more room for their roots, still continue making strong annual growth, and the fruit is larger.

All soils for the best culture of the cherry must be well drained, naturally or by under-draining. On dry knolls, otherwise favorable to the cultivation of the cherry, the moisture-content and moisture-holding capacity of the soil can be increased by the addition of vegetable matter, or by judicious surface cultivation. There are dry knolls is many places that are worthless for any other purpose, that could be made valuable for cherry production by improving the mechanical condition of the soil, by turning under, manure, green manures like crimson clover, cow peas or other legumes, and with frequent cultivation so change the soil into a deep retentive loam, in which fruit can be brought to its highest development in the dryest seasons.

LOCATION.

It is with the cherry as in all other fruits that push their buds very early in the season; the danger can be lessened if by any means the flow of sap can be retarded. Theoretically, this is all right, but we find little difference in practice. Exposure may in some instances make a few days' difference in time of blooming. For this

purpose an exposure to the north and northwest would be preferable, as the south or southwestern exposure hastens the development of buds in the Spring. But I would not, other things being right, go far out of the way for time gained. An elevation is always more favorable, as we have air drainage as well as water drainage, and where we have the former, and we have treated our trees right, we find they suffer very little from frosts, as the air drainage prevents frosts on the higher land.

Sour cherries will do better on lower or level lands than the sweet varieties.

DISTANCE TO PLANT.

The sweet varieties, when budded or grafted on the mazzard stock, and properly fed and given the care they should have, become very large trees, often thirty to fifty feet high, with a diameter of thirty to thirty-five or forty feet. Such trees should not be planted closer than the apple. If closer, best results cannot be expected; the limbs interlock, making it very difficult to spray the trees, or pick the fruit, and the loss is much greater from the monilia or brown rot, which in some seasons, if during the ripening there should be a couple days of rain, the entire crop is lost.

The sour cherries are usually set much closer, often too close for best results. Economy in saving ground by planting close generally proves false economy when the tree has attained its best fruiting age. The smaller growing varieties should not be set closer than 15x15 feet, and for the larger, spreading varieties, like the Montmorency, should have at least twenty feet each way and I believe it a paying investment to plant 25x25 feet each way.

PLANTING.

The sweet cherries are much more difficult to transplant than almost any other fruit tree. I believe I am safe in saying that not more than one cherry tree (propagated on the mazzard stock) out of every twenty, ever reaches profitable maturity.

Young trees not over two years old (and one year preferable) should be selected. If such trees could be obtained that had been raised on rather thin land, that have strong roots, and well hardened, but not stunted wood growth, successful transplanting would be much better assured. Were I to plant an orchard of sweet cherries I would much prefer to make haste slowly by getting my land in good tilth, and plant several stones of the mazzard cherry, whereever a tree is to stand, mark each place, and when the young trees have attained the size of a few inches in height, remove all but the strongest, most stocky ones. These I would bud the second year,

taking my buds from trees of well established, heavy bearers of choice cherries, for everyone knows there is a marked difference in uniformity of trees bearing. Some bear every year, some bear occasionally; others never bear. By this careful bud selection we can in a few years have a well established profitable orchard with a complete stand, which it is almost impossible to get by transplanting nursery stock, especially of fumigated trees, as we obtain them from the nurseries. Trees may be fumigated without injury, if the operator understands and minds his business. But I find that since all trees are required to be fumigated that the loss by transplanting is much greater. Even the hardy pear and apple are injured. At the Paragon orchards, previous to the fumigation act, one per cent. was considered a maximum loss. In the Spring of 1906 I purchased stock from the same reliable firm I have purchased from for years; of sweet cherries—40 per cent. grew; of the apple, 50 per cent. grew; of the pear, none grew. These trees all looked to be in first class condition, root and top. That they were injured by fumigation seems certain; several of the pears were choice varieties, and I used all the branches pruned off for grafting on other varieties. Of all these grafts, amounting to about one hundred, not one grew; whereas grafts set at the time by the same man, on the same variety of trees, but scions cut from unfumigated trees, there was not one miss. Unless there is some change made, the remedy is worse than the disease. The San José Scale we have already, but can control it. But we have no safeguard, if the law compels all trees to be treated and many killed before we receive them.

PRUNING.

The cherry tree should receive its principal pruning during its early years, and should be pruned to give it a spreading habit. The natural tendency of most of sweet varieties is to grow very erect, but if a head is started at about two or three feet, with four or five limbs, and these are given proper pruning, the tree assumes the same spreading habit as the apple, which has the same advantages of facilitating the gathering of the fruit, spraying, etc. But one of the most important things is the shading of the trunk, which prevents the danger from sun scald and bursting of the bark. While the tree is young, before the top is formed, the trunk should be protected. This may be done by wrapping or by pointing a six inch wide board and driving it firmly into the ground at the time of planting. This shauld be on the side exposed to the afternoon sun.

The top of the sour cherry should be started not over two feet from the ground, and afterward pruned as you would a peach, by cutting back about two-thirds of the growth for three or four years, and the top is thinned when necessary. The tree assumes the low,

Fig. 62.

spreading habit, as shown in Fig. 62. The greater part of the fruit can be gathered when standing on the ground, and the balance from a low step ladder. The sour cherries begin bearing at three years of age, and many of the trees in my orchards give over 100 quarts at nine years of age. It requires a much longer time for the sweet cherries to bear profitable crops although the Windsor bears good crops at eight to ten years of age.

CULTIVATION.

The cherry responds as promptly to cultivation and fertilizers as any other crop. If you wish for the highest success in cherry culture, thorough cultivation must be given during the early life of the orchard. There can be no serious objection to planting some hoed crop between the trees, provided sufficient fertilizer is applied to supply the wants, not only of the crop planted, but to meet the demand of the growing trees as well. The mistake is too often made by supplying the land with food enough only for the growing trees or for the secondary crop, when one or the other must suffer from lack of food. The sweet cherry is a gross feeder, and will thrive upon less applied fertilizer than most of fruits. When land is too rich, or too much nitrogeuous food is applied the entire energy of the tree may be devoted to the making of wood, and produce but little fruit. During the bearing season the cherry requires an abundance of water to mature and ripen its crop. The ground should be plowed early in the season, and be followed with the harrow. This should be kept up every few days and after every rain, until about the middle of July. The mechanical condition of the soil can be improved, and its water holding capacity increased by turning under annual crops of some green crop, preferably the legumes. These can be sown at the time of the last cultivation. This crop should again be plowed under early the following Spring. If it is left too long, or until the crimson clover has made a large heavy growth, it will add more humus and more nitrogen, but it will pump so much moisture from the soil that the trees will suffer during the ripening of the fruit, but if it is plowed under early the soil will return the much needed moisture and give it up as the maturing crop demands it.

Where the trees are making too vigorous growth, they may be checked by seeding the orchard down one year. As in all seeded or stone fruit, phosphoric acid is of special value in connection with nitrogeneous fertilizers, to aid in maturing not only the fruit, but also to mature and ripen the wood in the Fall. From three to five hundred pounds of dissolved rock and from two to three hundred pounds of muriate of potash should be applied annually.

MARKETING.

Very great care is essential in handling the cherry crop. The fruit must be carefully picked with the stems left on each cherry. The picker should never take hold of the cherry, but only the stem. A very convenient package for marketing is the eight pound basket, as in deep, large baskets the fruit is too heavy and presses the juice from the under layers. At the Paragon Fruit Farm we use the two bushel crates made up of four trays, each tray holding 16 quarts. Each tray is three inches deep. The cherries are not thick enough to press the under fruit, and carry in splendid condition. Large, deep packages, and poor picking, in which many of the cherries are bruised and pulled from the stems, is what causes so much dissatisfaction among growers. It arrives at destination in such poor condition that the commission man is compelled to dispose of it for what he can get, which is often not sufficient to defray expenses. In such cases the commission merchant is accused of dishonesty. Neat packages, with the top nicely faced with the stems hidden, pays well for time expended. This work is rapidly done by girls and women, by laying the fruit in straight rows across the box, fruit side down, then fill the box, nail on the bottom, turn the box and mark the faced side. If baskets are used the top of each basket should be faced. It is the fancy touches that attract the eye and opens the pocket book of the purchaser.

PROFITS.

This depends largely upon the skill, taste and business ability of the producer. At the Paragon Fruit Farm we grow the sour cherry principally. These, as before stated, are packed in crates, and sell wholesale at from 4 1-2 cts. to 6 cts. per pound, bringing in from $200 to $500 per acre. Fine sweet varieties, in fancy packages, bring higher prices, often realizing as much as 10 cents or more per pound. Cherries at these prices, with good yields, are very profitable, but as ordinarily raised and marketed they are not so remunerative.

VARIETIES.

There are a large number of varieties described in horticultural works and nurserymen's catalogues, and according to description they are all productive and good.

I will first describe some of the most profitable sweet varieties of the Bigarreau type. The light colored Bigarreaus are very susceptable to bruises and rot.

Of this type the Napoleon is the most valuable of the light colored ones. It is large, and has very hard, brittle, colorless flesh; light lemon yellow, with reddish cheek in the sun; a heavy bearer; rots badly, if not picked just before ripe, and splits in wet weather.

YELLOW SPANISH.

Large, obtuse heart-shape; beautiful waxen yellow, with bright red cheek in the sun; flesh quite firm, pale yellow, juicy, rich, sweet and delicious flavor. Last of June. Tree a vigorous grower, attaining very large size, with beautiful round spreading head, and very productive. Rots badly.

WINDSOR.

Originated at Windsor, Ont., by James Dougall. Tree is a vigorous grower, and one of the most productive of the type. Fruit large, liver-colored; flesh remarkably firm, and of fine quality. Valuable on account of its late ripening.

HEART VARIETIES.

Fruit heart-shaped, with tender sweet flesh, trees of rapid growth, with large, soft, drooping leaves.

BLACK TARTARIAN.

Origin, Russia. Tree a vigorous grower, upright, a great bearer, one of the most productive varieties in all parts of the country. Fruit very large, heart-shaped, uneven on the surface; purplish black; flesh half-tender, very mild, sweet, delicious, ripens about the middle of June. One of the best sellers among sweet cherries. This variety is not bitter when only half ripe.

GOVERNOR WOOD.

Origin, Ohio. Tree a fine grower, forming a round, half spreading head, very productive; liable to over-bear. Fruit large, roundish, heart-shaped; light, rich yellow, shaded and marbled with red, flesh almost tender, juicy, sweet, with a rich, delicious flavor. Early part of June. A profitable variety.

SCHMIDT.

Tree is a vigorous grower, very productive and remarkably hardy. Fruit grows in clusters and of the largest size; a deep black color; flesh dark, tender, juicy, with a fine, rich flavor.

SOUR VARIETIES.

Baldwin.—Tree a free grower and very productive. Fruit medium; skin bright red; flesh soft, juicy, tender, rather rich, sprightly subacid; ripening before Early Richmond.

EARLY RICHMOND.

Tree a healthy grower, hardy, forming a medium sized tree, with long, half pendant shoots; very productive. Fruit small to me-

dium; borne in pairs usually recognized by the calyx remaining on the stem next the fruit. Bright, clear red, brisk, rich acid. Early in June. The grower must be wide-awake if he gets any of the fruit, as the robin claims a proprietary right to this variety and begins harvesting it long before it is ripe.

MONTMORENCY ORDINAIRE.

Tree hardy, vigorous and productive. Fruit large, roundish; dark red; flesh tender, juicy, sub-acid. Very agreeable; one of the best flavored of its class. Ripens about ten days after Early Richmond. I consider this one of the best for all purposes, of sour cherries grown. With me it is very profitable, bearing heavy crops annually and owing to its large size and color it finds ready sale at good prices.

MAY DUKE.

Tree hardy, vigorous and productive. Fruit ripening gradually in succession. Makes fine dwarf or pyramids. Fruit large, roundish; dark, rich red; flesh tender, very juicy; rich and excellent sub-acid. Season middle of June.

LATE DUKE.

Tree a vigorous grower and a good bearer. Makes a fine dwarf or pyramid. Fruit large, heart-shaped, flattened; rich, clear, rather dark red; flesh tender, juicy, sprightly sub-acid. Ripens gradually. Hangs long on the tree, often until July.

REINE HORTENSE.

Origin, France. Tree healthy, vigorous, handsome grower; a moderate, even, regular bearer. Fruit very large, roundish; bright, clear red, marbled and mottled with yellow; flesh tender, juicy, slightly sub-acid; very good. Middle of July. A good market variety.

OSTHEIM (RUSSIAN).

Tree moderate grower, forming a dwarf, round headed tree. Very productive. Fruit large, skin dark red or liver color when fully ripe. Flesh very dark red, tender, juicy, very acid, with slight astringency. One of the best canning cherries grown; excellent for pies; too sour for eating from tree. This variety will prove valuable in severe cold localities on account of its extreme hardiness.

There are other varieties not described that are of value, such as Mercer, Black Eagle, Elton, Dyehouse, Late Duke, Royal Duke, Olivet, English Morello, Dikeman, &c.

ENEMIES.

Like all other fruits the cherry is subject to many enemies, insects and fungus. The brown rot (monilia fructigena) is one of the most serious diseases attacking the cherry. It is the same fungus that rots the peach and plum, and is well known wherever the stone fruits are grown. It affects not only the fruit when ripe, but frequently affects the flowers, leaves and twigs. The flowers of the sweet cherry are often entirely destroyed by it, as also happens with the peach, when the grower attributes the loss to frost. The fruit is particularly susceptible to the disease in hot, sultry weather, when its spread may be so rapid as to ruin the entire crop in one single day. The treatment for the disease is practically the same as in the peach, spraying heavily just before blossoms open, with Bordeaux. Again when the fruit is set, and as conditions require later. About ripening time the Bordeaux cannot be used, as it would render the fruit unsalable. The acetate of copper may be substituted, using six ouncese to fifty gallons of water, or two ounces sulphate of copper to the same amount of water. These do not stain the fruit, but if used too strong they cause the foliage to drop.

BLACK KNOT AND POWDERY MILDEW.

Are often serious on the sour varieties. These diseases have been described under another heading. The knot may be destroyed by cutting and burning; the mildew by spraying with Bordeaux early in the season.

LEAF BLIGHT.

Which is the same as the shot-hole fungus of the plum, is sometimes serious on the Morello cherries. This disease can be controlled by three or four sprayings with Bordeaux or acetate of copper. The first treatment should be given when the leaves first appear, and repeated at intervals of two or three weeks. Use the copper acetate before the fruit begins to ripen.

INSECT ENEMIES.

The principal ones are the black cherry aphis and the curculio.

The aphis is serious only on the sweet cherry. It is a small, black, sucking insect, which in some seasons are found in great numbers early in the season on the young shoots, on the under side of the leaves and stems. The presence of the insect is easily recognized by the abundance of honey dew it excretes, which covers the foliage and fruit; also by the curling upward of the leaves.

CURCULIO.

Two or three thorough sprayings of whale oil soap, 5 lbs. to 50 gallons of water, or kerosene emulsion, 1 part to 10 parts of water, are generally sufficient to eradicate the pest, but the spray must be applied as soon as the aphis appears, before the leaves curl. The soap or emulsion kills only by contact with the insects' body and if left until it is protected by the curled leaves, it is difficult to reach them.

Some seasons this insect is very troublesome, the larva being in nearly every sweet cherry. The treatment is the same as the plum. This is of course practical only on the smaller trees. It cannot be successfully carried out on large trees.

SUN SCALD AND BURSTING OF THE BARK.

Is a serious trouble with sweet varieties. The exact cause of the trouble is not definitely known, but it is by some considered to be due to the freezing and thawing of the tree. When the ruptures are severe they lead to decay of the trunk and often cause its death. Remedies, or rather preventives, are the formation of low headed tops, that the trunk may be shaded, and thus protected, and by the selection of such soils that do not favor too rapid growth of wood; and by such cultural methods as favor early maturity and ripening of the wood.

CONDENSED REVIEW.

The cherry interests of Pennsylvania are confined principally to roadsides, fence rows and door yards. Few large commercial orchards are planted.

The sweet varieties should be confined to rolling lands.

Sour varieties can be grown in nearly every part of the State.

The cherry thrives best in warm, dry, loamy soils.

The sour cherry likes more moisture and is hardier.

Clean culture until the middle of July is beneficial.

Orchards on elevated slopes, facing the north, may retard fruit buds.

Sweet cherries should be planted 25 to 35 feet apart each way.

Sour varieties should have not less than 20 feet each way.

Careful bud selection assures productiveness.

Sour cherries should be pruned like the peach.

Sweet varieties require little pruning after attaining bearing age.

Brown rot is the most destructive disease; controlled by spraying.

Aphis controlled by spraying.

Curculio controlled by jarring.

Sun scald and bursting of bark due to climatic changes.

Avoid nitrogenous fertilizers, stop cultivation by the middle of July, keep trunks protected by low top formation, select soil suit able. Follow these rules, and cherry culture may be made profitable.

PLUMS.

Plum growing as a special business is being rapidly extended; states which a few years ago were considered outside the plum belt now raise them by the hundreds of thousands of bushels. Plums for home consumption have also increased; yet there are hundreds of families in every county who do not have sufficient plums for their wants. The principal reason for the extension both commercially and domestically, lies in the introduction of new species, which has put new interest into plum culture, rendering it possible to again successfully raise this favorite fruit in sections, where the raising of the domestic varieties, was, owing to insects and fungus diseases proving a partial success or a total failure.

Space will not permit of entering into plum botany, or any lengthy description or discussion on the merits or demerits of the many varieties now before the public; but the methods of culture, varieties, insects and fungi injurious to plum culture, will be treated in as concise a manner as possible.

There are many distinct species of plums, prominent among which the Domesticas, Damsons, Myrobolan, Simon, Japanese, Americana, Nigra, Minor group, Wayland group, Wild Goose, Chicasaws, Sand Plums, and hybrids without end. But there are few of these that interest us in Pennsylvania. The first to be taken up will be the Domestica.

The Domestica plums probably had a common origin; they were doubtless evolved from the European Sloe; doubtless eastern Europe and west central Asia were the original home of the Domestica plums as we know them. Prunes are thought to have been introduced to Hungary from Turkestan, about 450 years ago; coming into Europe by way of Italy, France, and Germany. These plums were introduced into this country with the establishment of the first colonies, and new strains and varieties have been brought over since, from time to time. The most important importation of these plums was that made by the French colonists in Canada; some of these old French varieties are still cultivated as they were brought over.

The Reine Claudia or Green Gage group were recognized as a separate type from very early times. They were brought from France to Italy, about the year 1500 by queen Claudia, wife of

Frances I. The name Reine Claudia was given in her honor. The introduction into England came from Italy under the old name, Verdoch, and from France, with the labels lost; from this last lot came the Green Gage. These varieties come more or less true from seed; this has given rise to a large group of varieties—many of them originated in this country. These group characters are as follows, —foliage usually large, leaves broad and rather flat, with very coarse serrations; fruit nearly spherical with a few varieties slightly elongated; green or tardily turning to a dull, creamy yellow, occasionally with a faint pink blush; flesh rather firm, or even hard, green, clinging to the stone, some varieties partially free. The principal varieties of this group grown in this country are: Bavay, Green Gage, Lawrence, Imperial Gage, Jefferson, Washington, General Hand, Nonesuch, Bleeker, Peter's Gage, and Golden Gage. It is one of the most persistent types among the plums; it is also one of the best.

Prunes.—What constitutes a prune? Horticulturists vary in opinion. On the Pacific coast they say any plum that can be dried and sold as a prune. In the east we recognize a certain type or group of characters; they are as follows: trees and foliage, various; fruit mostly medium to large, always oval or ellipsoid, usually with one side of the oval straighter than the other; compressed; color blue or purple; flesh mostly greenish yellow, rather firm; stone usually free in a large cavity. The prune type is one of the most striking, and commercially the most important, of any of our cultivated plums. The principal ones of these are: The Fellenberg or Italian prune, German prune; there are several others more or less distinct—York State prune, etc.

Bradshaw type, commonly known as red plums. Best known among these are: Victoria, Duane purple, Giant prune, etc., the fruit is large, slightly obovate; purplish with distinct pinkish dots; skin thin comparatively soft, juicy flesh. These varieties are popular for home use and market.

The Domestica beyond doubt exhibits the highest degree of melioration known among plums, and show more improvement on the original stock than any other fruit in the entire horticultural catalogue. There is reason for this in the fact that they have been subjected to the improving influence of cultivation for at least four hundred years; whereas the Japanese varieties have not been carefully propagated and selected until they reached this country, within the last quarter century. This and the American species may have greater undeveloped possibilities. The future no man can predict; but for the present, this comparison of the evoultion progress of the several classes of plums is certainly fair. The Domestica are

more restricted in their adaptability to range of soil and climate than some of the others.

Damsons.—One of the oldest type of plums with which we are acquainted; and it is believed by many that they are the progenitors of the whole race of plums, from the fact that the Damsons are to-day found growing wild in quantites in Western Europe. They are hardy, thrifty and easy of cultivation; they bear regularly and abundantly; they are valuable for culinary purposes, and there is usually a good demand for the fruit.

The Japanese Plums.—Some thirty odd years ago the Japanese plums were introduced into America; but it is not more than half that time since they have been generally distributed among fruit growers. But within the last few years they have been more widely distributed than any other species ever introduced, (in fact we can attribute the advent and spread of the San José Scale to the general distribution of this fruit). They have been boomed and sold to planters as varieties proof against black knot, curculio, and other influences that injure other varieties. They have been planted out of all proportion to their relative merits, and many planters have been grievously disappointed.

They are strong growers, requiring severe annual pruning to hold them within reasonable bounds while young. The foliage is rich, abundant and comparatively free from disease; the blossoms appear early being the first plums to bloom, thereby in danger of severe late frosts; the blossoms are abundant, large, white, very strongly sexual; the fruit varies greatly in size, color, and quality as well as season. The fruit is firm rendering them good shippers and keepers; with few exceptions they are cling stones; the quality is only fair, never equalling the Domestica varieties. They have weaknesses in both tree and fruit. The tree although a strong grower is not ordinarily a long liver; they seem to suffer from a disease similar to the yellows in the peach after bearing a few crops. The tree looses color and the fruit becomes insipid, almost worthless. Nearly all the varieties are very subject to the brown rot. The varieties that do best are—

Red June. Medium size, heart-shaped, slightly flattened with a distinctly pointed apex; stem short and strong, suture distinct but shallow; color a dark red; no dots; heavy bluish bloom; skin rather thin; flesh very pale yellow; pit medium, semi-cling; quality fair; tree erect grower, productive, one of the earlist.

Burbank.—Fruit large, roundish, conical, compressed at stem; cavity large and deep; stem short and stout; suture variable but always plainly marked; color mottled and sometimes almost entirely covered with different shades of red, dark and coppery in the sun; dots numerous; bloom heavy light blue, flesh yellow, firm rather

dry, pit clings, quality when fully ripe good; tree vigorous spreading, an enormous bearer, fruit must be thinned, rots badly.

Normand.—Large, round, oblate, apple shaped with pointed apex, compressed at stem; cavity deep, broad; stem very short and stout; suture distinct; color clear yellow; bloom white, thin; flesh, firm; pit small almost free; quality fair, does not rot badly. One of the best yellow varieties of the Japanese plums.

Chabot.—Medium to large, roundish, conical with pointed apex, cavity medium, deep; stem short and stout; suture distinct; color yellow, partly overspread with bright red; dots minute, yellow; bloom lilac; flesh yellow, firm and juicy, cling; quality fair. Comes in late, good bearer.

October Purple.—Fruit very large, from one and three-fourths to two inches in diameter, roundish or somewhat oblate, compressed at the stem; cavity large and deep; stem slender; suture marked but not depressed; color greenish yellow ground over spread with purplish red, striped and splashed; dots numerous, minute, light, thin; white bloom; flesh yellow, rather firm, juicy, cling; quality not high but pleasing and refreshing; tree strong grower with spreading upright branches. One of the best of the Japanese varieties for dessert use, and of peculiar value because of its extreme lateness; medium productive.

Satsuma.—Fruit large, sometimes two inches or more, form nearly round; cavity shallow; stem short and stout; suture distinct; surface a little rough with slight bloom; dots dark brown; color dark purplish black; skin tough; flesh firm, juicy, dark purple; stone small nearly free; flavor tart; quality good. One of the best for canning or preserving. Tree strong grower, good bearer.

Abundance.—Fuit large, showy and beautiful, amber turning to a rich bright cherry red, with a white bloom, highly perfumed, flesh light yellow, juicy, tender, very sweet; stone small, semi-cling, has been more largely planted than any of the Japan varieties. Tree a strong grower, a prolific bearer. At the Paragon Orchards very few varieties are raised except the Japanese varieties and the prunes. Of the former—Red June, Burbank and Abundance; of the prunes—Fellenberg, York State, and Giant prune are our choice. In planting, varieties should be mixed as many varieties are self sterile.

CULTURAL NOTES.

The plum will succeed in almost any kind of well drained moderately fertile soil; although for best results a soil in which clay predominates is preferable, especially for the European varieties and the greater number of our natives, but no one need hesitate planting even on a sandy soil for home use.

Preparation of the Soil.—The plum, like all other fruits, responds to generous treatment and clean culture. But for limited planting about the home, merely to supply a succession of plums for family use, the trees must necessarily be planted in sod if there is no provision made for a regularly established fruit garden; and in sod, about the lawn and dwelling, plums may be very successfully grown, provided good care be given the trees. Even in commercial culture, where the ground is such that clean culture cannot be given, plums can be profitably raised. Liberal excavations at least two feet in diameter and one foot deep should be made for the trees, throwing the surface soil and the sub-soil in separate heaps. Where clean culture can be given the preparation and planting and after culture should be the same as other trees described under the separate heads. Young trees one or two years old should be chosen, and the pruning should be about the same as the peach.

ENEMIES TO THE PLUM.

Plum Curculio is one of the most troublesome insects infesting the plum; indeed it has become so troublesome as to render it unprofitable to attempt to raise plums of the Domestica type unless great care is taken to destroy the little Turk before it lays its eggs in the young fruit, or the greater proportion will drop before coming to maturity. These little beetles may be caught early in the morning, by spreading sheets beneath the tree, and jarring the branches by striking them a sharp blow with a padded mallet; some bore a hole in the trunk and insert a hard wooden or iron plug and strike this; this method does not bruise the limbs. The insects are then gathered together and destroyed. This work should be begun before blossoms open and kept up every other morning for at least two weeks after the blossoms drop. Chickens are a great help.

Brown Rot.—This is a troublesome fungus disease to which the plum is very susceptible. This can be reduced and sometimes entirely prevented by spraying with Bordeaux mixture, and later just before ripening, with a very weak solution of Sulphate of Copper, two ounces to fifty gallons of water; if stronger it will cause foliage to drop. An insecticide may be added to the Bordeaux mixture for the purpose of poisoning the curculio; some may be destroyed by this means. The mummies or dried rotten plums that hang on the trees over winter should be removed and burned.

Black Knot.—This disease is especially bad in neglected orchards and in trees growing along roadsides. In trees outside of cultivation, it fairly revels; here it spreads to neighboring trees, here it breeds. It occurs on all kinds of plums, contrary to statements made by tree pedlars. It also invests the cherry. When the Japanese varieties were first introduced, it was claimed they were immune,

but they are not; but they are less susceptible than are the Damsons and the slower growing Domestica varieties which are most easily affected with black knot. Black Knot is not a serious matter to keep under control; plum trees that receive the careful attention they should have, are seldom affected; occasionally when the season is especially favorable, and a neighbor's trees are full of knots, the spores may be carried to your trees and an outbreak may occur. The black knot is caused by a fungus and not as many suppose by an insect. It is true worms are sometimes found in these knots, but they are not the cause; they are the larva of the curculio. Often the curculio lays its eggs in the young succulent growth of the young knot; it hatches and passes the larva state therein; its presence being detected gives rise to the suspicion that it is the cause. The fungus grows within the tissues of the branches and twigs, but breaks through in ear'y spring, causing the familiar warty appearance. These warts are first yellowish; but during May or June they turn a darker greenish color and become shining and velvety; this velvety appearance is caused by an immense crop of spores which entirely covers the exposed part of the wart. These spores are mostly soon distributed, carrying infection to new trees. They usually lodge in the crotches of small branches, or in the axils of leaves or fruit spurs; here they germinate and soon penetrate the woody tissues, giving rise next year to new warts. Later in the fall the knots will be found to have turned dull black; on close examination they show a fine granular surface. This is caused by another crop of spores. These late spores are thick skinned and resistant of the weather; they live over winter and are able to originate new warts in the spring.

Remedies.—The best is the pruning knife; every twig should be removed on the first appearance of the knot and burned. Spraying properly done with Bordeaux mixture is an important preventive measure.

Shot Hole Leaf Spot.—This is also caused by a fungus. The trouble usually begins in the orchard early, about the time the leaves have first put out. The leaves take on an unhealthy look; they begin to show small discolored spots; these dots are yellowish toward the center and commonly have reddish margins. They gradually enlarge reaching a diameter of about an eighth of an inch. They turn darker, the tissues wither, and the entire center usually falls out, leaving a clean round hole which looks as though made with shot from a shot gun. This disease can be controlled by spraying with Bordeaux mixture; the first spraying should be made a few days after the blossoms drop, and the second about three weeks after the first.

Leaf Scab, Fly Speck Fungus, etc., are all amenable to spraying.

GUMMOSIS.

Every one raising plums, peaches or cherries has often noticed the accumulations of gum on the trunks and branches, sometimes this becomes serious nearly the entire tree becomes covered and often dies. It is found on trunk, branches, fruit spurs and even on the fruit. The cause some attribute to insects, to injuries, to bacteria, etc. All are to a certain extent right and all partly wrong. The mechanical causes are abrasions from single trees, hames, the splitting of limbs from wind or over bearing, from excavations made by borers, or the freezing of the trees. The fungus origin is most commonly monilia or brown rot. This disease injures the tissues in such a way as to be especially favorable for the formation of gum. On plums and peaches this gummosis following monilia, leads to a sort of canker. The exudation of gum especially where the fungus has attacked a fruit spur, results in an open wound; this is slow to heal, often never does, and in peach, often destroys the terminal beyond the point of attack. Gummosis is always a secondary matter; the way to treat it is to get at the primary cause. If due to borers, shot hole or others, apply the remedy for these; if from overbearing, thin the fruit; if due to monilia, spray; if due to injury from the single tree, discharge the hired man. Monilia is more often the cause, and spraying the most practical remedy.

APRICOT.

The apricot is thought by some authorities to be a cross or hybrid between the peach and our domestic plum, as it partakes of the characteristics of both, having the outward appearance of the peach, the skin being covered more or less pubescent, and the flesh somewhat resembles the peach; while the stone more closely resembles that of the plum. But this is all theory, and that the fruit is a distinct species is proven by the fact that it has never been known to produce plants from seed other than their specific types. Were it a hybrid, it would have a tendency to occasionally reproduce one or the other species from which it originated.

As grown in Pennsylvania or any of the Eastern States, the apricot cannot be depended upon to do as well either in productiveness or in size or quality, as in California or Oregon. But when planted in warm, congenial soil, light and rather thin, they make a strong, sturdy growth, come soon into bearing, and if properly pruned and fruit thinned they give very satisfactory results.

The apricot, like the peach, has fruit and wood buds mixed on the shoots of one year's growth. It has also little fruit branches or spurs like the plum, which are capable of being renewed by shorten-

ing. The mode of pruning must, therefore, be such as to produce young wood, and to maintain the spurs in a vigorous and fruitful condition. When neglected, it becomes, like the peach, denuded of bearing wood in the interior, and the tree becomes enfeebled by overbearing. The shoots should, therefore, like the peach, be shortened in each season, to reduce the number of blossoms, and produce new wood. This heading down should be done very early in the Spring, and the wood carefully covered with grafting wax, as the wounds are very liable to gum when large branches are cut off.

It is one of the first trees to blossom in the spring, and there fore in many localities the bloom is very liable to be killed by frost. It is always advisable, when possible, to plant on a northern exposure. On the north side of a building the bloom is somewhat retarded, and subject to less freezing and thawing.

The curculio and monilia or brown rot are very troublesome. To overcome the latter, the trees should be sprayed heavily in March or beginning of April, with standard Bordeaux mixture. After the petals fall they should be again sprayed with a more dilute Bordeaux, No. 3. In seasons favorable to the development of this disease several sprayings may be necessary. The fruit must also be thinned the same as the peach and the plums. As a further aid, and to prevent the winter killing, to which the apricot is very subject, apply an abundance of potash and phosphoric acid, but avoid too much nitrogenous food, so the growth will be more moderate, wood harder and shorter jointed. It will then be able to withstand severe winter weather with little if any injury.

VARIETIES.

The number of varieties that do well in Pennsylvania are very limited. One of the best of the early varieties is the Early Golden. This is rather small, an inch and one-fourth in diameter, round oval, nearly smooth, surface pale orange, flesh orange, moderately juicy, sweet, good, free from the stone. Ripens fully two days before the Moorpark. Tree hardy and very productive. Good for family use and market. Origin, Dutchess Co., N. Y.

Early Moorpark.—Resembles Moorpark, but ripens earlier. Medium in size, roundish-oval. Yellow, mottled with crimson in the sun.

Sante Fe.—Originated in Florida. This variety gives more satisfactory results at the Paragon Fruit Farm than any other. It is medium in size, roundish; yellow, mottled and tinged with red in the sun; flesh tender, sweet, high flavored; separating freely from the stone. Tree very hardy in wood and bud, bearing good crops when other varieties fail. Early.

Large Early.—Fruit large; orange, with red cheek; flesh sweet, rich, and excellent; parts from the stone. Tree vigorous and productive.

Moorpark.—One of the largest and finest apricots; yellow, with red cheek; flesh orange, sweet, juicy, and rich; freestone; growth rather slow, but stout, short-jointed. Very productive.

Royal.—Large oval, pale orange; flesh firm, juicy, rich, vinous; ripens just before Moorpark. A valuable variety; not very productive with me. There are a great many other varieties more or less valuable, but those mentioned are considered best. The apricot, though one of my favorite fruits, has never proved a very profitable crop commercially, and I would advise testing well before planting extensively.

THE QUINCE.

The quince is a small growing tree or bush, about ten or twelve feet in height. It is not as extensively raised as other fruits, as the demand for this fruit is limited, being used principally for jellies and preserves, and for giving additional flavor to some other fruits.

It is generally propagated by layers or cuttings, the methods of which are the same as for other varieties of trees and shrubs.

The soil for the quince should be deep and rich. In fact it will require more fertility than almost any other fruit, and continuous cultivation is very beneficial. An application of a heavy coat of good stable manure every year or two, together with a good sprinkling of muriate of potash applied early in the spring is very beneficial. Some recommend the application of salt, but I prefer the muriate of potash, as it contains all the salt necessary, with the addition of the potash so necessary for the highest development of all fruits.

The planting of the quince is the same as with other trees. They require more moisture than many other fruits, but the same law holds good. Thorough drainage must be had. I have seen the quince do exceeding well on a race bank, where the soil was made up of filled ground. It was high enough above the water level to keep the roots from standing in wet ground, yet capillary attraction furnished sufficient moisture to always supply its wants.

Pruning.—There are two methods of training the quince. The one most commonly adopted is the bush form, having several stems starting from the ground. This method is thought by many to produce more fruit, and if properly pruned they bear very heavy crops. The neatest and most artistic method is the single stem, with a head

started at eighteen inches or two feet from the ground, and if rightly pruned they form beautiful round open heads, producing fruit of the highest quality. If planted commercially, the trees should be set about fifteen feet apart, which will be found plenty close enough for full grown trees under good culture in fertile soil. If the ground is well prepared by deep plowing and well fertilized, the trees will come into bearing in about three years.

VARIETIES.

The strongest variety is the Angers—a variety used for budding the pear to make dwarfs. It is slower in coming into bearing than the other varieties, but when once it reaches maturity it is a good regular bearer. The fruit closely resembles the orange quince.

ORANGE.

This variety has in past years been more extensively planted than any other. The tree is a more slender grower, but very productive. The fruit is large, roundish, with a short neck; color a golden yellow. Ripens in October. One of the best for all purposes.

CHAMPION.

A variety originated in Connecticut. The tree is a very strong grower, and very prolific. It ripens later than the orange, and the fruit can be kept a long time in good condition. The fruit is large, very handsome, of excellent quality.

REA'S SEEDLING.

Originated in Green Co., N. Y. Tree a good grower, and early and heavy bearer. A magnificent fruit, much larger than the orange, and considered by many to be superior to it for culinary purposes.

MEECHES PROLIFIC.

This variety is a late introduction, claiming to be the most productive variety grown. The fruit is of good size, very smooth, and beautifully colored. Quality the best.

There are other varieties in cultivation, but are not of sufficient distinction and merit to occupy space in describing them.

ORNAMENTAL VARIETIES.

The principal one is the Japan.—Cultivated as Pyrus Japonica. It is used entirely for ornamental purposes, and for hedges, which when in bloom, with its bright showy flowers and the rich green foliage, makes it one of the most attractive hedges grown. By pruning back a few times it becomes so thick that rabbits cannot pass through.

MULBERRY (*Morus.*)

The mulberry is but little grown in this country, as the home demand is small, and but a very limited supply can be sold in the markets. The majority seen throughout the country are such as came from seeds scattered by the birds, which are very fond of them. Several years ago the Russian mulberry was introduced and extensively planted in the West for post timber. It is a very rapid grower, and if pruned it soon makes valuable timber. It is perfectly hardy, notwithstanding a temperature several degrees below zero. The fruit is also valuable when planted where chickens have their range. They are very fond of them, and by their long continued bearing they furnish considerable food. They are also valuable varieties. The season is long continued, some varieties ripening about the same time, they attract the birds which take them in preference, leaving the cherries to ripen unmolested. They are prolific bearers. Fruit rather small, but sweet and good.

The mulberry thrives upon nearly all soils, making a large, handsome tree as large as the apple. The fruit drops when ripe and may be gathered by spreading sheets under the trees and shaking them. The fruit is soft, somewhat tart until fully ripe, when it becomes very sweet, and the majority of people are very fond of the better varieties. The season is long continued, some varieties ripening continuously for several weeks, well deserving the title of overbearing. The varieties most generally cultivated are:

THE BLACK MULBERRY (MORUS NIGRA) A NATIVE OF PERSIA.

The tree is highly ornamental, very erect, with large, spreading head. The leaves appear late in the spring, are large, heart-shaped; sometimes lobed, deep green, and form a dense shade. The berries are very large, about an inch and one-half long, and three-quarters of an inch in diameter, black, succulent, sugary and rich.

OVERBEARING (DOWNINGS).

A variety grown from seed by Charles Downing, and regarded as a very valuable fruit. But it is not sufficiently hardy in Pennsylvania. The terminals of nearly all of the last season's growth freezes back every winter is the temperature falls near to zero. Fruit large, one and one-fourth inches long, and one-half inch in diameter. Color from maroon to a blue black; flesh juicy, sugary, sprightly vinous. It ripens gradually for a long time in succession.

NEW AMERICAN.

This is one of the most dependable varieties grown. The tree is a very strong upright grower, forming a large spreading head.

It is very hardy, an annual heavy cropper, continuing through a long time. The fruit is large, one and one-half inches long by one-half inch in diameter. Color black, flesh rich, juicy, sweet. The best variety to plant in Pennsylvania.

CHINESE VARIETIES.

Used for feeding silkworms; belong to the species Morus Alba and Morus Multicaulis. These varieties will never have any value in Pennsylvania, and any one will plant those bearing edible fruit in preference.

GRAPES.

Without wishing to introduce evolution, it is nevertheless more than interesting speculation to account for the origin of the five great classes into which the grape genus naturally divides itself. Though these classes differ widely from each other, they seem to have had a common origin or starting point, and that the variations are due to adaptations, to differing climatic conditions; so that we have in the different localities, in the plants now occupying the ground, the best examples of fitness of their respective types. Space will not permit going into details on these various species. Yet it is not without interest as to how it came about that of these five species four are native of the United States, while only one of them is found wild in the vast Eastern continent. But it seems the genus originated in America, and that receding before the gradual advance of the ice sheet, at the time when the elephant roamed the Dakotas, one section was split off and finally found a congenial home near the Himalaya Mountains, for in that one locality it is found wild, while all over Northern America the wild grape is a familiar object in our forests.

The widely distributed Vulpina (Rigaria) represented by the well known Clinton. This type can stand great cold, but suffers in dry soils and hot weather.

2. Bourguiniana, or the Southern Aestivalis group. This species is best adapted to the warmer climates, as they can withstand heat and dryness, but suffer in severe cold.

3. The true Aestivalis or summer grape is a native of the Southern and Middle States. This species is pre-eminently the wine grape of the South. The berries are destitute of pulp, but a large per cent. of rich juice. The most genial home for this species is Missouri, South Kansas, Arkansas, the mountain slopes of Virginia, North Carolina and Tennessee. This is the great wine belt of the Continent, east of the Rocky Mountains. The Norton or Cynthiana

is the best of the type, and one of the best red wine grapes we have. Its product cannot be excelled by the best red wines of the Old World.

4. The Linoecumii, a native of the South-west. Not of high merit, possessing a flavor peculiar to itself, that is carried even to its wines.

5. Vitis Labrusca is a native of the Eastern and North-eastern states of the Union. A large number of the varieties in cultivation are either pure or partly Labrusca grapes, and the largest (berried) ones of all the native species considered here. A few of the pure Labrusca varieties are Concord, Ives, Champion, Hartford, Worden, McPike, Martha, etc. Labrusca Vinifera varieties are Agawam, Jefferson, Lady Washington, Moore's Diamond, Campbell's Early, etc. If we could by crossing of hybridizing the different varieties retain all the good points of the parents without imparting any of their faults, we would soon reach the acme of perfection in grapes, but seedlings show rather the faults and bad qualities of the parents than the desirable features. At the present time we have a large list to select from, still there is room for more better ones.

Pennsylvania has many favored localities that seem to be especially adapted to the planting of vineyards on a commercial scale. But owing to the prolific bearing and the short season in which the crop must be harvested, many have been deterred from planting. Of late years the crop has not proved a very profitable one, not nearly as much so as some of our larger fruits, as the apple and the peach.

To plant a vineyard the same precautions are necessary as in planting other fruits to secure sufficient recompense for its culture.

Soil must be dry. If the situation is wet it must be thoroughly underdrained so no stagnant moisture can exist in it. In the next place it must be deep; not that the grape is a deep-rooted plant, as we find the majority of the wild grapes have their roots very near the surface, but we find a good depth of soil being more retentive of moisture without being wet, favors the best development of this luscious fruit.

Preparation of soil is the same as described in another place; deep plowing and harrowing to put it into loose friable condition.

Planting.—More failures with the grape are due to deep planting than any other cause; deep holes are dug, and the roots are put straight down and planted like a post. The result is it often stands, making but little growth for a year or two. In fact, it never will make much growth until new roots are formed nearer the surface.

Two methods can be adopted: one is to mark out a large furrow, one man take the plant, lay it lengthwise with the roots spread on the bottom, and with the stock held on an incline, another man with a shovel throw ground on the roots and back of the stock. This

is then packed by tramping it thoroughly. The other method is, after the row is marked, one man will open the holes by starting his shovel at an incline, throwing out a shovelful of ground; the next shovelful is thrown out at the same incline until finished, when it resembles the cut in Fig. 63. This is a taper hole, about two feet to two and one-half feet long, about six inches at the deepest point, tapering to the level of the ground. Another man then lays the plant on this incline with the roots nicely straightened and about two or three buds above ground. A few years ago I planted 1,300 vines by this method and not one failed to grow. They made new growth from four to eight feet the first season.

Distance Apart.—Grapes are generally planted too close, both in the row and the rows too close. The latter should not be less than ten feet apart, for convenience in cultivation and giving space to drive through between each row, to haul off the trimmings and to gather the fruit. They should also be planted ten feet apart in the row. This gives ample room for the spread of the roots, also for tops, without crowding the trellis.

Fig. 63. C. Represents the excavation made for planting. B. The vine as planted. A. The stake for marking where the vine stands.

A very nice plan is to lay the vineyard out in blocks about 250 feet long, holding 25 vines to the row and about the same number of rows. This makes it very convenient for driving through to gather the fruit, &c. Short-jointed varieties, as Delaware, &c., would find room enough if planted six feet apart in the ten first rows, but where land is not more expensive than in Pennsylvania it will pay well to give them plenty of breathing space, and we insure ourselves ease and convenience in working and gathering.

Propagation.—It does not sufficiently interest the planter about the methods of propagating the vines, as there are large nursery firms that make a specialty of propagating the grape, and who, being prepared with suitable soil, &c., for the purpose, produce such excellent, well rooted vines at such extreme low prices that it will not pay the man who wishes to set out a few thousand plants to bother with them when he can buy a thousand strong, one-year-old Wordens or Concords for $16.00 to $18.00, and other varieties proportionately cheap.

The Age.—I prefer very strong one-year-old vines, well set, with stout roots, which are pruned back to suitable length, and the tops are also pruned back. It is of course evident there is no one method of pruning and training vines, which is all wrong, nor any other which is all right. The method must always be modified by circumstances—the purpose for which it is planted, the species, the ideal which the grower has set for himself. Every one has some particular method that he thinks looks better, and if that method is one at all suited to the wants or requirements of the tree or vine, then that is the method he should adopt, for he will take more delight in the raising and give better attention to its careful training than if it does not please his views. Better drive a small stake beside the small vine to mark the place, and cultivate your vines the same as you would a hill of corn. Let what growth it makes run over the ground as it will, and if you wish extra strong growth sprinkle a handful of bonemeal in the hill at the time of planting and it will yield you many pounds extra of choice fruit in the years to come. This is all you need to know of grape growing for the whole first year, giving you plenty of time to study and learn. And this is also true of the next and succeeding years—you will need to learn only a little at a time.

The next spring, before vegetation starts, cut away all the growth made by the vine during the past summer, except one or two buds again, and cultivate the little vine again this summer as you did the first season, and let it again trail over the ground as it pleases, while growing, and the next spring early cut it back again to one or two buds or eyes, as you have already done twice before. This coming winter, the third winter of our little vine, the ground should be thoroughly plowed, as this is the last opportunity to do this as well as it can be done now, harrow well crosswise to level your ground as well as possible, and it would be well if the plowing be done at right angles to the way the wires are to be on the trellis. For the trellis we use round chestnut posts about 7 feet, plant a post at the end of each row in a straight line five feet from the last vine, so as to allow the end vine room to extend its arm. The second post is then planted 20 feet from this down the row, which places it midway between the second and third vines. The third post is planted 20 feet further down the row, between the fourth and fifth vines, and so on until the last post. Treat every row the same, being careful to place the posts in straight lines each way. The finished appearance will be well worth the extra care bestowed upon it. We are now ready for the wires and we need only one of the three as yet this year. Some use No. 12 wire, but I prefer a No. 9 gauge. Stretch the wire about 24 inches from the ground and staple to the posts, but do not drive the staples up to bind the wires, but leave them

have plenty of play in the staples, and leave yourself about 8 feet of slack at the ends and make a turn around the post, fastening the slack along the wire; go to the other end and pull the wire fairly taut, seeing that you draw it through the staples, and fasten this end as you did the other, or better have ratchets on either end, for the two or three hundred feet of wire will expand and contract about one-and one-half inches with the temperature between our warmest and coldest weather, a range of say 100 degrees. To prevent this winter contraction from pulling the ends of the post in, the wires should be slackened in the fall and tightened in the spring. This wire should be in position before the buds start in the spring.

Our vine has already been cut back to one or two buds, but now comes the tedious wôrk, to tie a little cotton string to each vine, slipping a noose loop over some projecting point or crook, and tying the other end to the wire directly over the vine. For this purpose cotton carpet chain is about the best. The hank can be opened out and cut at one time to strings of equal length, and a bundle of such strings can be fastened to the waist and a single string drawn out at a time. We tie it loosely to the vine, so as the vine grows it will not become strangulated before the string rots.

The purpose of this string is to guide this year's growth up to the lower wire to form the permanent stem, and it will be divided at the wire to form out two permanent arms, which resemble the two lower branches of a tree and always remain. This method of training is known as the "Horizontal Arm System," and since our arms are to be permanent all our subsequent pruning is done on the shoots or canes growing from thes arms.

When the new shoot has reached the wire, then the other shoot or two that we have permitted to grow so as to make sure of one, are broken out and the energy of the plant is concentrated to this one shoot and in the next step we have a choice of two methods of procedure. We want no more upright or vertical growth this season, but we do want two horizontal growths or canes, one extended each way along the wire. We can get these canes in two ways. The first, by letting the shoot continue to grow upward as much as we dare, considering its liability to being broken off by the wind, say 10 or 20 inches, then bending it down and tying it to the wire, choosing the direction least liable to break it. This bending down has a tendency to check the flow of sap and causes a temporary check, but very soon, if the vine has not already done so, there will be a shoot start out at the base of each leaf, but all these shoots coming out below the wire are to be rubbed off, except the upper one just under the wire on the opposite side to the end tied down. This one we allow to grow and tie it along the wire to form a cane or arm to correspond to the one already formed in the other direction.

Of course this leaves the arm much the weakest of the two, since it is only a branch, while the other is the main body of the vine, but it will catch up and be practically as large as the other before the growing season is over, inasmuch as each of these arms are pinched back when a growth of two to two and one-half feet has been made. And the main stem reaching this size first is soonest pinched or checked, while the other arm whose growth is not then checked by pinching keeps growing until it also reaches its limit, and by that time it is as strong as the other.

The other method of securing two arms is, as soon as the vine reaches the wire, pinch off the head or tips. This, after an apparent temporary stoppage of growth, will cause the shoots to put out at the base of each leaf, and all these, as in the other case, are to be rubbed off except the upper two which we train along the wire for our arms, one to the right and one to the left. In actual practice a combination of these two methods nearly always results. These shoots, branches or arms are carefully but very loosely tied along the wires. We tie them loosely so as to allow for the increase in size, since the arms, and therefore the ties, are permanent. In this case it were an advantage to have our tying material that it would not decay. For this purpose wire hooks made of No. 12 annealed galvanized wire, shaped somewhat like a ringed fishhook, should be used. They should be about two inches long and an inch or an inch and one-half across the end, and the eye at the other end about one-fourth of an inch in diameter, with the end that forms the eye turned a little sidewise, that it may be slipped over the wire and when hanging vertically cannot come off. These hooks can be made very rap-

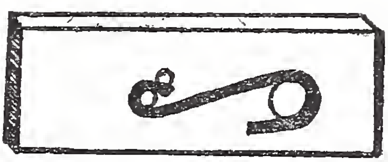


Fig. 64. Shows pattern and hooks for tying grapes.

idly when accustomed to it, using a shaper made by taking a solid block of hard wood, boring an inch hole and screwing a nipple of a three-fourths inch gas pipe into it, one inch and a half from this bore a one-fourth inch hole and put a 40-penny wire nail through, cutting it off, leaving a stub about one inch high a fourth inch from this and on one side put another; then screw this block of wood in a vise to hold it firm. Cut the wires to a proper length, insert one end between the two nails, bend the wire around the nail stub, between this and the nipple, continuing around this, forming the complete hook. Pattern and hook shown in Fig 64. A smart boy can

make several thousand in a day and with these one man can tie up several times as many vines as by using strings. If the vine does not want to stay in place, slightly close the ends. These wires never strangulate the vine.

As stated, the arms are pinched off when they get about two and one-half feet long, as it is better not to attempt to get our full length five-feet arms the first season, as we are aiming to get them stout. After the new vine is pinched off at its proper distance it is the usual custom to leave the vine to its own device for the rest of the season, but it is wise to go over it once or twice as follows: We should not allow any shoots to remain below the arms, as the arms should absorb the whole strength of the plant. As soon as the growth has been checked by pinching new shoots will start out at the base of each leaf along the arms, and it will add much to the sturdiness of the vines if we pinch back these new shoots after they have made two or three leaves, and repeat this again later on. It is especially desirable to treat the last buds toward the end of the arms in this way, holding this one in check so as to prevent its running out and becoming practically a continuation, or a substitute for the arm we have endeavored to limit to two and a half feet, and thus draw the strength away from the other short branches we are trying to develop evenly and uniformly all along the arm, at every joint, and so secure strong, healthy buds for next year's work at the junction of every one of the short branches, with the arm; for these points or places are the business centers of the vine, and we must aid and develop them all we can.

We have now reached the end of the third season, and if any little buttons or embryo branches of fruit have made their appearance they have been promptly removed. Very early next spring we do our real pruning, and this consists of merely cutting off all the little branches or canes that we had pinched off last summer, and we cut them off within half an inch of the arms, that is, below the last bud; for we want our season's growth to come from the buds that we have developed at the base of the branches, in the angle between the branch and the older wood of the arm. The shoot that comes from these buds bears out fruit next season, having two to four branches to each shoot, depending upon the variety. Here and there some one vine may have grown so vigorously that it will be safe to let it bear more fruit than the average of our vines, and so we will not prune it so closely, but leave one bud on several or perhaps all the canes, which will leave the little spur two or three inches long, long enough, at any rate, to contain one bud and an inch or so of wood beyond the bud. If you are tempted to leave one or more buds for more fruit, and are in doubt whether you should do so o not, in every such case cut it off, for spare the knife and spoil the

vine would be a good maxim, and you can hardly cut back a grape vine too much, while many are ruined by being allowed to overbear.

No fruit is more liable to do this than the grape vines, and we must never forget that our pruning is for the sole purpose of limiting the fruit to be borne the next season and keeping our vines in working shape and condition.

Now when our vine is trimmed it consists only of the upright stem, and the two arms with the short spurs on them, like a caiptal T, and they will present a very uniform appearance.

During this winter the remaining two wires are to be added to our trellis, the first 12 inches above our lower wire, and the upper one 15 inches above the middle one, stapled loosely like our lower one, and the ends again secured to the end post with ratchets, or with sufficient slack to wrap around the posts, and the trellis is complete.

The next summer will give us our first grapes, from one-sixth to one-third of a full crop. If more than one shoot starts from a bud or joint, rub off all but the strongest one. These shoots will tend upward and take hold first of the second wire, and then to the upper one. In some sections it is the custom to pinch off these shoots when they reach the upper wire, but as they droop over with their own weight soon after reaching the upper wire they thus far themselves check the flow of sap to the outer ends, and so devote their energy to developing the foliage and fruit.

But the shoot coming from the last bud toward the end of the arm is not permitted to bear any fruit, as this cane is intended to form the extension of our arm, and so we pinch off the embryo fruit as soon as it makes its appearance and tie this shoot down along the lower wire, and when it reaches a length to make the whole arm about five feet long it is pinched off and the shoots that start out on the new green growth are pinched off and treated just as the shoots were last year on the older part of the arms.

In this form of trellis the fruit hangs below the lower wire and between it and the middle wire, high enough from the ground to permit of a free circulation of air and is also sheltered from the burning rays of the sun by the foliage that is above and around it.

Our vine is of course cultivated again this summer, but it should be continued later than the middle of July and the light growth of weeds and grass that start up will do more good than harm, as it shelters the ground and prevents the leaching action of the winter and the early spring rains, and when plowed under returns to the soil some valuable nitrogeneous matter.

The next winter, our fourth, the two-year part of the arms can be so pruned as to bear a double quantity of fruit by leaving spurs of from one to two buds each and cutting these canes or branches on the new

part of the arm back as close as we did the year before. The next succeeding spring, however, we treat this new part of the arm just as we are treating the old part this year, for after the pruning there will be no difference made between the two parts; always remembering to keep one or two buds on the cane of last season's wood growth, bearing in mind you can make no more serious error than to let your vines overbear. So if in doubt, therefore, whether to cut, then cut; make it a rule to prune very closely and your little vine will last longer than you will.

We have now kept the vines to a point where they are capable of doing an honest seasons' work, and where nothing new or strange will come up in it's life's history except, if perchance one of its arms becomes disabled, then it must grow a new one, or we may be compelled to cut it off at the ground and make it go over the whole process again. But if it meets with such an accident it can do this now on its established roots in two years instead of five, when it was young and inexperienced. I have endeavored to touch the principal parts in the training of the vine in this five-year school, space not permitting a more lengthy detailed description.

The illustrations will render it plain, Fig. 65 showing trellis with vine at end of third year or spring of the fourth, and Fig. 66 shows vine at end of fourth or spring of fifth.

The Renewal System.—This method is practiced by many extensive grape growers. In Missouri nearly all vineyards are trained by this system, which consists in yearly cutting away all the wood of two years old or more. The vine is taken at the close of the second summer, with, as supposed, three good strong canes grown from a point near the ground; two of these canes are cut back to from four to six feet, according to the strength of the vine, and are tied to the lower wire in a bow shape (see Fig. 67) while the third cane is cut back to three or five buds, depending upon the vigor and age of the vine. The long bent canes are for fruiting, while on the shoots that grow from the center all the fruit is removed. The next season the bearing canes are cut away, two or three new canes are laid in for fruit, the center cane cut back as before, for shoots, and so on from year to year the practice is repeated. This is a most excellent method and gives choice fruit.

VARIETIES.

The number is already too great, and is being increased annually. Yet we have room for the ideal grape. I shall not attempt in this limited space to give but a few of those best adapted to Pennsylvania and that will stand a temperature of 20 degrees below zero. It will save space by putting them in tabular form, with abbreviations that will fully describe them. Those followed by b. are black, those

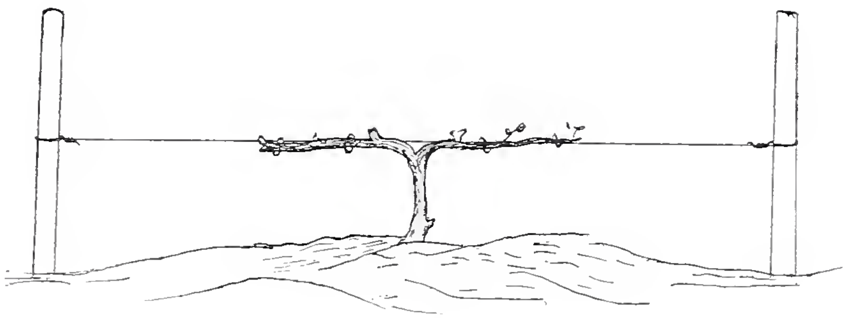


Fig. 65. Shows a vine trained on the horizontal arm plan, at the end of the third year.

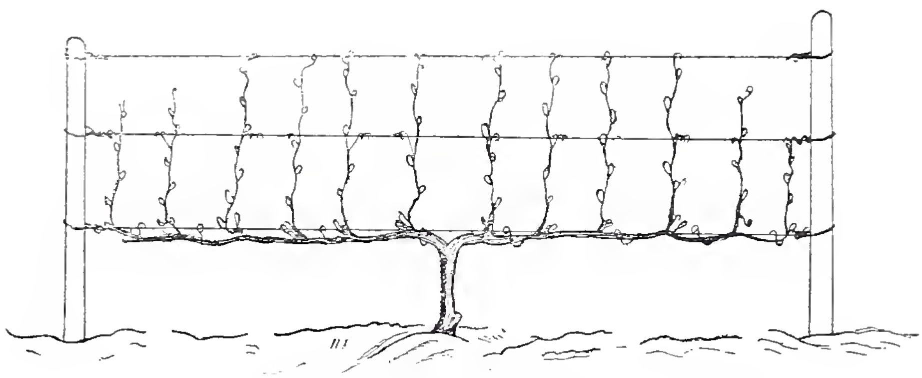


Fig. 66. The same vine at the end of ourth year.

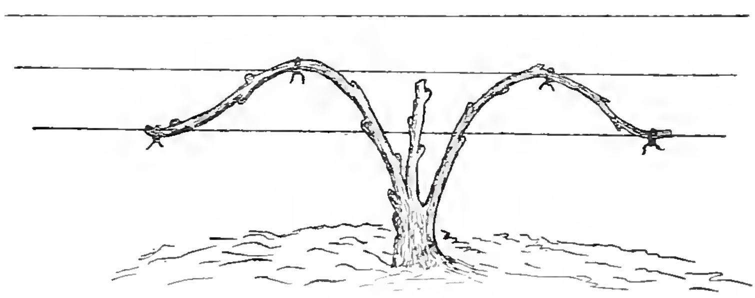


Fig. 67. Shows vine trained on the renewal system.

by y., yellow; by r., red; e., early; ve., very early; m., medium; l., late; vl., very late; md., subject to mildew where spring and summer is very moist; such can be grown by spraying with Bordeaux mixture. Those followed by smbc. are small to medium in berry and cluster; those by mbc. are medium in size of berry and cluster; those by lb. are large in berry; those by lc. are large in cluster; those by mc. are medium in cluster; those by mb. are medium in berry; those by t. are somewhat tender.

1. Brighton (md.), r., l., t., lbc.
2. Catawba (md.), r., l., t., lbc.
3. Concord, b., m., lbc.
4. Delaware (md.), r., me., t., smbc.
5. Diamond (md.), w., me., t., smbc.
6. Green Mountain, w., l., mbc.
7. McPike, b., me., lcb.
8. Moores Early, b., ea., lb., me.
9. Niagara (md). w., m., t., lcb.
10. Worden, b., me., lcb.
11. Wyoming, r., e., mcb.

INSECTS INJURIOUS TO THE GRAPE.

GRAPE CURCULIO.

This is a small beetle belonging to the family of curculios. It passes the winter probably in the perfect state, and lays its eggs on the young grapes some time in June or early in July. The young larva when hatched enters the fruit and begins to feed upon it, its presence being indicated by a discoloration on one side of the berry, as if it was prematurely ripening. A dark colored circular dot soon appears in the middle of the colored spot, showing the spot where the insect has entered the fruit. The berry does not decay, but remains plump. Late in July or early in August the larva matures and falls to the ground, and, burying itself in the soil changes to a pupa, from which the beetle escapes late in August or early in September.

Remedy.—Jarring the vine during the month of June. The best is to bag the fruit before the eggs are laid.

ROSE BEETLE.

Too familiar to need description.

Remedies.—They may be poisoned by spraying the vines with arsenite of lead. Or, as they are a very sluggish insect, they may be shaken from the vines in early morning, when they are congregated

together. With slight jarring they tumble to the ground. By spreading a cloth before jarring they may be gathered and destroyed by scalding water or coal oil.

There are many other insects sometimes troublesome, but generally not plentiful, such as the flea beetle, the grape vine saw-fly, the leaf hopper, grape vine aphis, the trumpet grape gall and others. They are all troublesome to combat. Spraying with the soluble oils is among the best remedies.

FUNGUS DISEASES.

THE BLACK ROT.

This is the most generally destructive fungus disease of the grape in the United States. Like most fungus diseases it develops with the greatest rapidity during damp, hot weather. The black rot fungus usually appears first on the leaves in the shape of small, sharply defined reddish dots having yellowish centers, and dark brown or blackish borders. In about a fortnight later it becomes noticeable on the fruit. The first appearance on the berry shows itself as a light brown spot, caused by the decay of the underlying pulp, this pulp increasing in size so as to involve the entire berry. Simultaneous with this change the parts first affected turn black and become covered with minute black pustules. Finally the entire berry dries and shrivels, the skin crumpling into angular folds.

TREATMENT.

Treatment.—Spray with the Bordeaux mixture five to eight times, beginning when the buds begin to swell early in May. If the Bordeaux mixture is used, substitute the ammoniacal solution of copper carbonate for the last two sprayings, to avoid spotting the fruit.

DOWNY MILDEW.

This is commonly known as the brown rot, and is distributed over the eastern portion of the United States and occurs both upon the wild and cultivated grapes. It probably lived upon the former before the introduction of the latter. It appears usually about the time the vines blossom, producing upon the leaves a distinct whitish mildew, which has earned for it its common name. The fungus spreads to the newly formed berries, coating them also and causing them to fall off. When the larger berries are attacked their growth is checked and they gradually turn grayish or brown.

Remedy.—The same as for black rot.

GRAPE ANTHRACNOSE.

This disease attacks all the green parts of the plant, usually doing the most damage to the young shoots and the fruit. On the former it appears at first in the shape of small, round, brown spots, depressed in the center, and having a slightly elevated dark colored border. As the shoots grow the spots gradually elongate, and their middle portions become more distinctly depressed, because of the killing of the tissue. It first appears upon the fruit as a small grayish spot, having its margins dark brown. The spot gradually enlarges, and there is frequently developed just inside the dark brown margin a bright vermilion ring. On account of this the disease is often called the bird's-eye rot. As the fungus progresses the growth of the berry is checked and it finally becomes a dry, withered mass of skin surrounding the partially developed seeds.

TREATMENT.

Treatment.—This is a difficult disease to prevent. The treatment recommended is to cut off all injured canes during the winter and early spring before the buds start, to spray the vines thoroughly with strong copperas (iron sulphate) solution 10 pounds copperas to a barrel of water (50 gallons). In case the disease appears, a powder composed of equal parts of sulphur and lime may be dusted on, or the Bordeaux mixture may be applied. I believe the lime-sulphur mixture would be one of the best preventives, applied just before the buds expand. It is the great fungicide.

There are many other fungus diseases that space does not permit discussing.

SPRAYING.

In this enlightened age it will be unnecessary to go into details as to what we mean by spraying. There has been so much talked and written about spraying that every one is familiar with the subject. All that will be necessary will be to treat in as condensed form as possible of the various formulae, their preparation and application, and the various appliances to be used for the purpose, and the seasons when they are most successfully used. These sprays may be divided into the following classes:

1. Poisonous sprays that kill by being taken internally.
2. Poisonous sprays that kill by contact.
3. Fungicidal sprays to prevent the development of fungi.
4. Sprays that combine the two.

1. POISONOUS SPRAYS.

The principal poison used is arsenic, or one of its salts, known as arsenious acid, white arsenic; of the salts, the one best known and most extensively used is

PARIS GREEN.

This should be of a bright green color, and should contain not less than 50 per cent. or arsenic, nearly all of which should be in an insoluble form, as free arsenious acid is very destructive to foliage. As we find it in the market it is frequently adulterated with gypsum, flour and white arsenic. It may be used in the form of dust, when it should be mixed with from ten to twenty parts of lime, flour, ashes or dust.

It is more commonly used mixed with some liquid, as water, Bordeaux mixture, &c., when it is used in the proportion of one pound Paris green to 100 gallons of the liquid. If water is used it is always safer to add about two pounds of lime to neutralize the effects of the acid and prevent scorching. If to be used on tender leaved plants, like the peach, it should be still more dilute; one pound to 200 or 300 gallons. To make it more adhesive, add one quart of molasses to 50 gallons of the spray. Owing to the many impurities in the preparation as well as the high price charged for it, a cheap and effective substitute may be used, called,

ARSENITE OF SODA.

This can be made cheaply as follows:

Heat 2 pounds of white arsenic with 6 pounds of sal soda (common wash soda kept in a grocery store) and two gallons of water. Boil the material in any iron pot not used for other purposes, until dissolved; put the solution in a jug; label it poison. One pint of this is equal in strength to one-quarter pound of Paris green. In preparing your spray, if for codling moth, add one and one-half pints to fifty gallons of Bordeaux mixture, or 50 gallons of water to which 4 pounds of fresh slaked lime is added. This is the cheapest insecticide that can be used, costing about one-fifth of a cent per gallon.

ARSENITE OF LIME.

Formula.—White arsenic, 1 pound; fresh burnt lime, 2 pounds: water, one gallon. Boil together until clear, taking about three-quarters of an hour. Use one quart of this to 50 gallons of water or Bordeaux mixture. This is for masticating insects. This will burn peach foliage; more lime must be added to the water.

ARSENATE OF LEAD.

This is one of the best of all the arsenical preparations, less liable to burn the foliage, being the least soluble. It can with safety be used on delicate leaved plants and trees like the peach without fear of injury. It also adheres longer than any of the others, one application frequently remaining on the foliage several weeks. It is much more expensive and requires a stronger spray, but when we consider that one application will often do the work of two other preparations it reduces the cost and labor.

Formula.—Dissolve four ounces of arsenate of soda, 50 per cent. purity, in two quarts of water in a wooden pail. In another wooden pail dissolve 11 ounces of acetate of lead (sugar of lead). To dissolve quickly use hot water; hold these separate until ready for use, then pour the two solutions into 150 gallons of water or Bordeaux mixture. This is the strength used by many, but I prefer using it somewhat stronger. I use 5 ounces arsenate of soda and 14 ounces acetate of lead, dissolve separately and pour into 100 gallons of spray material. For convenience the substances can be weighed out beforehand in the proper proportions and tied up in bags so it will take a bagful of each for a 100-gallon tank. This is a good strength for codling moth, &c.

Arsenate (not arsenite) of lead can be purchased put up in packages from 1 pound to 50-pound kegs of Wm. H. Swift & Co., 45 Pearl street, Boston, Mass. It is strange, but drug houses in Philadelphia and New York do not handle it. It can be purchased under the name of Disparene of the Bowker Fertilizer Company, but it will cost more money. If used in ready prepared form it will require from three to five pounds to 100 gallons of spray.

LONDON PURPLE.

This preparation is little used by fruit raisers, it being very unreliable and seriously scorches the foliage. If used, plenty of lime must be added to prevent the burning of foliage.

In using any of the arsenical preparations in connection with Bordeaux mixture, care should be taken never to mix the arsenate with the spray material until ready to apply it, as with all of them more or less chemical action takes place between them and the copper salts, in the Bordeaux mixture, which injures the combination as a fungicide or an insecticide.

There are two other preparations of arsenic much used in some sections. The first of these is "Green Arsenoid. "This closely resembles Paris green. This contains more free arsenious acid, from 3 to 5 per cent.; it also contains too large a per cent. of sodium sulphate and sand. The other is Paragrene. This is composed of arsenious

acid, oxide of copper, acetic acid and about 36 per cent. of gypsum, which is of no value but adds to the weight. This is a very inferior form to use.

To test the purity of Paris green take about as much Paris green as will lie upon a five-cent piece, put it into a glass and all about six tablespoonfuls of household ammonia; stir all the time and continue stirring for about five minutes. If the green is pure a dark blue solution will be formed and no residue will remain undissolved. If calcium sulphate is present, however, a white residue will remain suspended in the blue liquid, which will soon sink to the bottom of the glass in a compact mass.

2. INSECTICIDES BY CONTACT.

Of these we have many different forms, but only those of direct interest to the agriculturist and horticulturist will be discussed. One of those commanding especial attention because of its specific action upon the San José Scale is the

LIME-SULPHUR AND SALT.

The use of this spray in California dates back many years. For several years, owing to the many failures, it was pronounced ineffective in the East, owing to unfavorable climatic conditions. But by thorough trial it has in every instance proved a complete success when properly made and applied. I have been using it for several years in the Paragon Orchards without one single failure, even on trees so badly infested that they were condemned as incurable. There are many formula, many methods of preparation, all more or less effective, according to the completeness of the combination. There are the boiled washes, the self-boiled washes, with salt and without. All have their advocates; all methods have their successes and their failures.

FORMULA.

The object is to obtain the most effective spray at a minimum cost, with the least amount of labor. Boiling by fire or steam is the means usually employed to bring about the combination of the lime and sulphur necessary to make the wash effective. But as this process is slow, tedious and laborious, many other processes have been tried to bring about the union without cooking. For this purpose additional lime and the addition of caustic soda, or caustic potash, have been used with varying success. After a series of tests at the Ohio Experiment Station with the boiled and unboiled, of different proportions, it was proven that those boiled by steam, in the following proportions, gave the best satisfaction, killing the largest percentage of scale: Lime, 20 pounds; sulphur, 15 pounds; water, 50 gal-

lons. This seems to be the happy medium. When more sulphur was used, with or without salt, the percentage of scale killed was not greater. When less sulphur was used, with or without salt, the percentage of killed scale was not so great. When a greater amount of lime was used, it did not add to the value, but made a thicker wash, more difficult to spray, often clogging the nozzles when the mixture became nearly cool.

BOILING BY FIRE.

The ordinary farmer's orchard of a few acres will not warrant the expensive steam cooking outfit. They must therefore resort to cooking by kettles, but even here there are two methods, the right and the wrong way. Many people think it economy to take a small iron kettle, suspend it to a tripod or by a chain thrown over a rail suspended on two forked stakes driven into the ground. This is false economy, and I never saw any man make a success by this method. It is practically impossible. Should the day be windy, it is utterly impossible to keep the heat distributed around a kettle suspended over an open fire. To get the combination desired requires a continuous boil (not a simmer) from 45 minutes to 2 hours, with close attention and almost continuous stirring. Now, in busy times, as it always in the spring, no man can afford to have one or two men fooling away two hours cooking enough material for 50 gallons of spray, then have three out of four cookings a failure. The cheapest outfit, if you cannot afford a better, is to get at least a one-barrel kettle, have an iron tripod made that the kettle will be held 10 inches above the ground. Measure the diameter of the top of your kettle, have the tinsmith make a sheet iron jacket one inch larger in diameter and just high enough to come even with the top of the kettle when it is on the tripod, have a door 10 inches square put in the jacket from below, have a No. 9 wire around the jacket above and below. This jacket concentrates the heat, the space between the jacket and the kettle gives draft, and fire and heat all around the kettle to the very top. It does not require half the fire, and the combination will be had in less than half the time without failure. In placing the jacket put the door toward the wind to give draft and regulate with the door and damper. As long as I cooked by fire I used a large iron cooker made by Hess Bros., Michigan. This was a cast iron kettle holding 75 gallons, with a steel jacket, with smoke pipe and damper attached. With this one man could cook and dilute about 800 gallons per day, always holding one kettleful partly dilute in the kettle over night ready for an early start for the sprayers in the morning. My original plant, before I put in the steam plant, was built against a side hill, shown in Fig. 68 The kettle stood on a level and at one end of the lower platform, upon which are two mixing tanks. This

platform is about eight feet above the graded roadway, so that the diluted spray can be run by gravity from the mixing tanks through alone and one-half inch gate valve and pipe into the spray tank mounted on the wagon. Back of the first platform is a second one, four feet higher, upon which stands a large water tank. To the left of the lower platform and kettle will be noticed another large cooking tank in which boiling water is always kept on hand. This tank is made of two-inch planks with a heavy sheet iron bottom. The base, or furnace, upon which this rests, is built of brick, with a brick chimney extending two feet above the tank. Upon this is two sections of six-inch terra cotta pipe; this gives good draught. In this long furnace full length cordwood can be put. In the rear stands the building in which the material is kept. There is a driveway between this building and the cookers, and on a level with them. This is a very convenient outfit, and gave us very good satisfatcion until my increasing orchards outgrew its capacity. The portable part consists of a low-down wagon, with a platform that extends over the wheels; upon this is mounted the Niagara gas sprayer, which will be shown and further described in Fig. 69. My method used at the Paragon Orchard and how I prepared it over a fire.

Formula.—Lime (fresh burned), 40 pounds; flowers of sulphur, 34 pounds; salt, 15 pounds; water, 100 gallons.

It is economy to have two kettles to always have boiling water, as it saves much time. Fill extra kettle with water and start boiling. Put about 18 gallons of water in the cooking kettle and start the fires. While this is coming to a boil weigh your ingredients; when water boils, take a couple of gallons from the cooking kettle and pour it into a barrel. Pour your sulphur on this, add a little more water and stir the sulphur; add more water as needed and stir until you have a smooth paste. Add a little more water, making it thin enough to pour. Now place the lime in the cooking kettle; as soon as the lime strikes the boiling water it immediately starts slaking; pour your sulphur paste in quickly to get the advantage of the intense heat created by the slaking lime. Great care must be taken or the lime will burn fast to the kettle, become dry and rough and be difficult to get in condition. To avoid this the moment the sulphur is poured on top of the slaking lime, commence stirring the lime with a stout paddle made for the purpose. Push this forcibly from above downward all around the kettle, that it does not fasten and burn. In a few minutes it begins to stir easier and works smoothly. I then use a stirrer made like those used for cooking apple butter, with a handle about six to seven feet long fastened to the shorter piece. At the bottom of this short piece nail a board about 12 inches long, 3 inches wide and rounded at the bottom to fit the kettle. With this the mixture can be stirred with ease and kept from adhering to

the sides and bottom. The time required is uncertain; it depends upon the fire. But one thing is sure, if you wish success you must cook until you have the proper combination, and the safest guide is by the color. It is first white, streaked with yellow, then becomes yellow, gradually changing to an orange color, becoming darker until of a tomato red, then like hard boiled catsup, when it will soon change to an olive green. When you have this color you know it is cooked enough. If you stop short of this, you may not have the combination desired, and failure will be the result. Now add more water, nearly filling the kettle with the boiling water from the other kettle. This makes it handle better and strain easier. Place a strainer over your mixing tub and dip the entire mixture from the kettle and pour through the sieve.

How to make a sieve for this purpose.—Take a strip of one-inch board 4 inches wide, saw two pieces each 10 inches long; saw two others each 24 inches long. Nail these together to form a square box 10 inches on the inside. This leaves 6 inches extending beyond the square at both ends. On bottom of the square tack a 12-inch square piece of brass wire cloth, 20 meshes to the inch. This makes a cheap and lasting strainer convenient for use. To keep this from slipping it is well to cut a piece out of the arms as shown in Fig. 68, Fig. 69 barrel strainer.

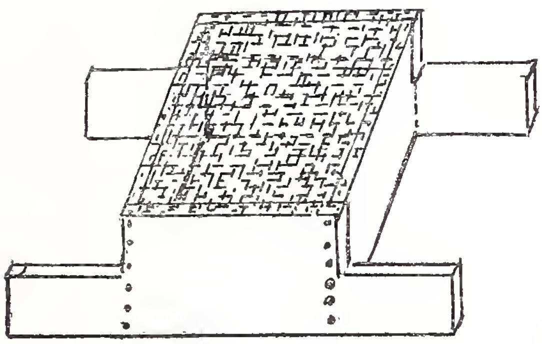


Fig. 68. Strainer for material when taken from the kettle.

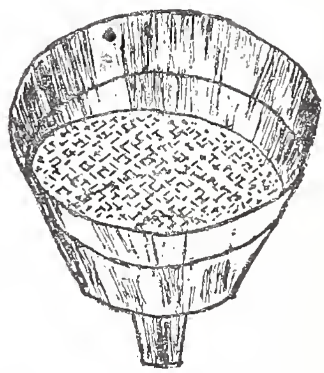


Fig. 69. Funnel with strainer set at an incline, used on spray tank.

After the mixture is strained, dilute to 100 gallons and run it through a finer strainer, 26 meshes to the inch, into the spraying tank. This strainer may be in the form of a large funnel, with the wire cloth set on a slant inside, one side starting a little more than half way up, the other nearly the bottom of the opposite side. Set this way it seldom clogs, or it may be formed into a cone and set inside the funnel or a bucket made for the purpose. These are shown in Fig. 70. Never use copper, as the lime, sulphur and salt eats it through in a short time. Never let a batch of lime, sulphur and

salt stand over night unless kept hot or reboiled next day, as it throws down silver-like crystals which embrace the active ingredients of the spray and so clog the nozzles as to render them very difficult to work.

Since I am cooking by steam the past season I have changed my formula. I now use 40 pounds lime, 30 pounds sulphur, no salt. Results have been excellent.

In spraying peach, never use salt; it is safer. You always risk injury to the buds by using salt, especially in fall spraying. The danger is not so great in the spring application.

My modern steam cooking outfit consists of a building 20x32 feet, built against a side hill, with a driveway at the lower side, just inside the building; this is 12 feet wide. Next to this is a 7-feet wide platform 8 feet from the level of the driveway. This extends the full width of the building and is on a level with the back entrance of the building. Over the driveway is a platform 12 feet by 20 feet. This forms a convenient place, giving ample room for the sulphur, lime, a platform scales, &c. This is 2 feet higher than the lower platform and access is obtained by three steps at the end nearest the back entrance. Back of the lower 7-feet platform is another platform 4 feet higher than the first and 5 feet wide by 16 feet long. On this platform stand my cooking tanks, four in number. This platform is 4 feet shorter, leaving a 4-feet passageway from back entrance to the lower platform. Access is had to this platform by an easy sloping gangway from the storage platform, being much easier than steps. Over this last platform is a track suspended beneath the roof. On the track is a carrier with a clutch pulley; this is attached to the handle of the barrel for mixing the sulphur. This handle is fastened to the barrel on either side a little above the center. When the sulphur is ready to dump into a cooking tank on the line, the barrel is pulled up, the clutch pulley holding it at any height desired; it is then pulled along the track until opposite the proper tank, when by catching hold of the top and bottom it is easily turned and poured into the cooking tank. Immediately over each cooking tank is a half-inch steam pipe with a steam valve; the back end is attached to a one-inch pipe further back against the roof out of the way. On the end over the tanks is an elbow, then a 4-inch nipple, to this a swinging joint, then an 18-inch piece of pipe, then another swinging joint, then a piece of pipe long enough to reach down nearly the bottom of the tank. On the bottom of this pipe is put a tee, on each side is a 6-inch nipple, each of these has a cap on the end with a small hole about one-eighth of an inch. The nipple has also three small holes on each side. This is to distribute the steam equally through the mixture. It will keep the bottom free from sediment, requiring no stirring; the steam is all absorbed and brings water quickly to

a boil. It requires just 11 minutes to boil 50 gallons of water with 60 pounds pressure of steam. The swinging joints act like hinges, permitting the steam pipes to be raised out of the tanks and folded above out of the way, leaving the tank clear while putting in the lime and sulphur. When ready, the operator pulls it down into the barrel and turns on the steam. Back of this last platform is the large horizontal boiler in which wood fuel is used. This is of ample size to cook four tanks at once, if needed. The boiler is on a level with the lower platform and with driveway in the rear of the building. The floor of the boiler room is cemented. Another large water tank is placed in this room, in which hot water is always kept. This is high enough above all the tanks to run hot water by gravity where wanted. About 75 feet from the building on a higher elevation is an underground concrete cistern holding 2,200 gallons of water. From this a 1-inch pipe carries the water down to a hydrant in the building. The bottom of the cistern has elevation enough to run the water by gravity in any of the tanks.

Every tank has an inch and one-half gate valve which, when the material is cooked, runs it by gravity through a strainer into the mixing tank where it is diluted. These mixing tanks are graduated, so no measuring is required. From this tank it is again run by gravity through a finer strainer into the Niaraga sprayer on the wagon. The water is pumped by a 2-horsepower gasoline engine from a never failing well. From the time the water leaves the well until the material is cooked and in the spray tank but little manual labor is required. All the work could be done by an intelligent 12-year-old boy. There is no slop, no waste; any fumes generated by cooking are conducted from the building by means of ventilators in the roof and in the ends of the building. With this outfit an ample supply is always on hand, so that the spray wagon is never held up, and neighbors are frequently supplied at three cents per gallon, including material and labor. If we wish to hold over night (which we always do) we dilute in the cooking tank to within 8 inches of the top, making about 40 gallons, bring this to a boil, turn off steam, remove steam pipe and cover tank tightly. The material will be quite hot in the morning, when we again turn on steam and bring it to a boil.

UNBOILED OR SELF-COOKED L. S. S.

The fact that the ordinary lime and sulphur requires boiling has kept many from using it, in spite of the small cost even when boiled. In large orchards, where suitable outfits can be procured, the question of boiling is not a serious one, but in hundreds of small orchards and gardens the trees would be sprayed if some easily made mixture could be used. There is a demand for a mixture that can be pre

pared without hot water, and this has prompted many scientists to try various things with a view of supplying this demand, among others the preparing of the lime, sulphur and salt wash without boiling, and this has met with fair, if not complete success. In this preparation caustic soda was used in some cases and in others no soda was used. In the latter case the formula and method of preparation to be recommended are as follows:

Stone lime, 40 pounds; sulphur, 20 pounds; salt, 15 pounds; water to make 50 gallons.

Put about 12 or 15 gallons of boiling water in a tight, heavy barrel, stir in the sulphur, then add the lime and quickly cover with blankets, or sacking. A long, heavy paddle for stirring the mixture should be left in the barrel, with the handle sticking through the covering, by means of which the mass can be stirred to keep the lime from setting, but it should not be agitated sufficient to cool it off much. By having the lime broken in medium sized lumps, and using care in the manipulation of the paddle the mixture can be kept boiling by the aid of the lime alone for 10 to 15 minutes. The salt is added at the end of the boiling period. Such a mixture is easy to prepare, and when carefully made, has given very good results. But when the facilities are had for cooking, the latter method is less trouble and gives uniformly better results.

Never attempt to keep it warm by keeping a jet of steam in it over night, for should your fire get low and no steam be generated, a vacuum will be formed and the mixture will be drawn from the tank into the boiler.

WHEN TO USE.

Lime, sulphur mixture can be used only when trees are in a dormant condition, either in the Fall after the foliage has fallen, and in fine weather during the Winter, when the spray can dry without freezing, or in the Spring. Experiment has shown it to be most effective in the Spring just before the buds expand. It has also the advantage of more material remaining on the trees during the Summer, which acts as a deterent to the young lice attaching themselves.

Lime and sulphur is also a powerful fungicide, a specific for peach leaf curl, destroys lichens, keeps the bark clean and healthy and destroys germs in the soil, as a large proportion of the spray falls, and covers stones, ground and vegetable mould, destroying any spores adhering to them. Other insecticides by contact, are the oils and their emulsions.

CRUDE OIL (PETROLEUM).

This oil has been used extensively in many sections for the San José Scale; in some instances with apparent success, in others almost a complete failure, always with more or less injury to the trees. I have examined large orchards that had been sprayed with crude oil that were in worse condition than if the scale had been left unmolested, as the trunks and larger branches were seriously damaged, the bark was hard, rough and cracked, the cambium had lost its healthy color, and was unable to perform its function, while the smaller branches and terminals were as completely covered with the scale as if they had not been sprayed. These trees were in much worse condition, because both trunk and top were injured, the latter by the scale, and the former by the oil.

KEROSENE.

This has been used successfully in some instances, but it requires an excellent outfit that gives high pressure, very fine nozzles, manipulated by a man with good judgment, an ideal day, in which evaporation takes place rapidly. It is always attended with danger. The emulsions are much safer; the one best known and most commonly used is

KEROSENE EMULSION.

When kerosene is put into an emulsion it is safer, as the strength is known to a certainty.

A stock emulsion is made as follows:

Hard soap, shaved fine, one-half pound; kerosene, 2 gallons; water, one gallon.

Dissolve the soap in the boiling water, remove from the fire and add the kerosene while the water is boiling hot, stir rapidly with a paddle, or churn with a spray pump, by pumping it back upon itself until it becomes a creamy mass. This is kept for a stock mixture in which the oil will not separate. This is two-thirds kerosene, and one-third water, which is always carried in mind when diluting.

For the scale and hard bodied insects, use one part emulsion to four or ten parts of water. For soft bodied insects, when trees are in foliage, use one part emulsion to 15 or 20 gallons of water. For use in large orchards or even a few trees, the neatest mixture that can be used with safety is some one of the soluble oils. There are several of these placed upon the markets under various names, such as Scalecide, Emulsified Con-Sol, Kiloscale, etc. They have been tested at the various experimental stations and in private orchards. Some of them gave very satisfactory results, others not so satisfactory. But whether satisfactory or not, they are very

expensive, as most of them sell for $1.00 per gallon in small lots, and 50 cts. per gallon in barrel lots. They are to be used, one gallon of the emulsifier to 20 gallons of water, which costs from 2½ cts. to 5 cts. per gallon for the emulsion ready to apply to the trees. The convenience is the one strong point in their favor. Put the water in the spray tank, pour in the soluble oil preparation at the rate of 1 to 20; agitate, and it is ready for application.

For those who wish to use the soluble oils, I will give the formula for making the so-called soluble oils at less than one-third the cost of the ready prepared articles, and fully as effectual, which will reduce the spray material to less than one per cent. per gallon.

SOLUBLE OILS.

This is a misnomer. The oil does not dissolve. What is here called soluble oil is an emulsifier consisting of oil, carbolic, and caustic potash in certain proportions; at a temperature of from 275 to 285 degrees, Fahrenheit, it is formed into a soap. This in turn is put into a certain proportion of kerosene, which dissolves it, forming a concentrated oil. To this is added more kerosene. This is the soluble oil. When certain proportions of this is added to water, it forms an emulsion which is used as a spray. To give the reader a little better understanding, further explanations will be necessary.

When a fat or oil is finely divided into globules, and remains suspended in water, without running together, it is called an emulsion. Mechanical force is not sufficient to do this; no matter how finely the globules are divided they quickly run together. Some reagent seems always to be necessary; for this purpose soaps, carbolic acid, ammonia, etc., are used. The two latter alone will not cause emulsions, but used in conjunction with soap they improve it. Such preparations, capable of forming an emulsion when mixed with water, have received the name of soluble oils, and while an emulsion is very different from a solution, the very opposite to it; viz., an insoluble mixture, yet the term is convenient and is used to denote the petroleum preparation ready to mix with water.

Common soap dissolves in water; it also dissolves in kerosene, provided there is not too much water present. So far as we can understand, the cause of emulsion such as here proposed, it seems that the soap first dissolved in kerosene and then thrown into water, dissolves in the water, and in so doing divides the kerosene into exceedingly minute globules, which for some reason remain apart for a time, whether minutes, hours or months.

MATERIALS.

A large number of soaps might doubtless answer as emulsifiers, some of them purchasable on the market, others to be especially

made. As is well known, soluble soaps—and they alone will answer the purpose—are compounded of a fat or fatty acid, and either potash (soft soap) or soda (hard soap). Both kinds are efficient emulsifiers, but the soda soap, or hard soap, is much more difficult to dissolve in kerosene; requires more heat and when dissolved leaves a solid body, slow to mix with water. Potash soap can be brought to a fluid or semi-fluid state and can be dissolved in kerosene much more easily. When soaps are made especially for the purpose, caustic potash may be used, when it can be obtained—the granulated caustic potash, containing about 54 per cent. caustic potash, 21 per cent. caustic soda, and 25 of water, is the best form. This can be purchased of A. H. Seemuller & Co., No. 225 N. Water Street, Philadelphia. There are two oils that are especially adapted to the purpose, viz., red oil or commercial Oleic acid, and Menhaden, or fish oil. The latter seems especially adapted to making an emulsifier; these oils can be purchased from the same firm.

The carbolic acid should be the grade known as liquid crude, one hundred per cent. straw color. This can be purchased of the Barrett Manufacturing Co., Land Title Building, Philadelphia, Pa.

Of the ready made soaps, suitable for the purpose, is the Olive Fig Soap. It is a soft soap, containing 50 per cent. true soap and 50 per cent. water.

Ratios—To avoid misunderstanding, let the precise meaning of ratio be understood. It must not be confounded with the proportion of water that is mixed with the soluble oil in the spray tank. The term does not refer to the "20 to 1", or the "15 to 1", that the user of soluble oil considers when he adds one gallon of it to 19 gallons or 14 gallons of water in making his spray mixture. But it refers to the proportion that exists in the "soluble oil" itself between the sum of the soap, carbolic acid, ammonia, etc., and the petroleum oils, the ratio between the total emulsifier and the oils emulsified.

To simplify calculation, the potash is omitted and the menhaden oil or red oil, the carbolic acid, and the ammonia water, if any is used, are added together and called the emulsifier, and the proportion it bears to the petroleum present is the ratio.

For example, in Formula No. 1, one gallon red oil and two gallons carbolic acid are called for, making three gallons. Now as 18 gallons of kerosene is called for, the ratio is 18 to 3, or 6 to 1. As the ratio becomes lower, the certainty of success becomes greater. With suitable material, and the surest way to test material is actual trial on a small scale—a 10 to 1 ratio ought to be infallible and a 20 to 1 practically certain. Some soluble oils, when thrown upon a large volume of water give instantly and spontan-

eously a deep white emulsion, without preparation of any sort. Others similarly treated will give chiefly or wholly free oil floating on the surface. Now if these latter have a small quantity of water added to them first, and if the mixture be agitated slightly until it forms a uniform cream, then when this cream is thrown upon a large quantity of water, there may result an excellent emulsion, with no free oil.

A notable peculiarity of emulsion seems to be that if they have once formed with no free oil, they may then be diluted with water indefinitely, without further separation, and an emulsion seems to form with greater certainty in a relatively small body of water than in a large. Thus "soluble oils" made up at high ratio will sometimes separate at once into clear oil, if they are at once mixed with ten or twenty times their own volume of water, but if they are first mixed with their own, or half their own volume of water, and vigorously agitated, a thick even cream is formed, that will, on being diluted with a large quantity of water, give an excellent emulsion, showing no free oil. In other words, a good emulsion may be induced by manipulation, when it would fail if attempted directly.

On the contrary, certain soluble oils made up at so high ratio as 25 to 1, or 35 to 1, will give at once a dense, white emulsion if they are mixed directly with 10 or 20 times their own volume of water. Such emulsions are called spontaneous, in distinction from the manipulated. We do not always succeed, however, in making high ratio soluble oils that will give spontaneous emulsions, and it is difficult to find the cause of failure. In the manipulation, a volume of water about equal to that of the soluble oil seems to be best suited.

There is little difficulty in getting spontaneous emulsions with low ratio oils. With the proper materials there is seldom trouble in securing such emulsions, for soluble oils at 10 to 1 and even 20 to 1 ratios, and for all practical purposes this is probably high enough. Spontaneous emulsions are the most convenient, requiring no skill to use it beyond measuring the proportions, and mixing with the proper amount of water. But some soluble oils will work spontaneously only at a relatively low ratio, yet if they are manipulated at first, with a little water they may be made to work successfully at a higher ratio.

LOW RATIO VS. HIGH.

To determine which is the most efficient is difficult, unless we know how it is expected to work. Whether mechanically like a powder, stopping up the spiracles of the insect, or by its solvent or caustic action, like an alkali; whether the efficiency is due en-

tirely to the petroleum oils, or whether something must be credited to the soap proper, or to one of the auxiliary emulsifiers, carbolic acid and ammonia. This point is important. It is important, if possible, to determine whether petroleum oils alone, provided they are properly emulsified, will prove effective against the scale, and at the same time spare the tree, and also to determine what, if any, useful part, either soap, carbolic acid or ammonia may play otherwise than emulsifiers. Shall we regard as the best emulsion the one that has the highest ratio, that is the least emulsifier in proportion to the kerosene, or the contrary, the one with the lowest ratio? Are the soap, carbolic acid, etc., merely necessary evils, hurtful and costly, yet necessary to the emulsion itself, or are they valuable as on their own account, destructive to the scale. Mixtures of high ratio, that is, little soap, carbolic acid, etc., and much oil, are preferable on account of economy, provided emulsification is the sole object. On the other hand, they are less desirable because they are harder to make, and the emulsion is less certain, demanding more skill and experience.

The high ratio has a maximum of kerosene and a minimum of emulsifier, depending entirely upon the kerosene as the insecticide. The low ratio, or drastic soluble oils have less kerosene and depend in part on the virtue of the emulsifier as an insecticide. It is probable the season of the year may determine largely the character of the spray materials. It is probable the drastic (low ratio) mixtures will be safe, yet more efficient when trees are dormant; whereas, the high ratio or mild oils will be more suitable for Summer sprays. Carbolic acid is favorable to emulsifying, and will permit a higher ratio, yet an excess is unfavorable to emulsifying. Red oil seems to work best with double its volume of carbolic acid, while menhaden oil requires less than its volume.

Carbolic acid has several distinct offices. It acts as a solvent for the fats; it increases the possible ratio at which soluble oils will emulsify; it renders the soluble oils more fluid, preventing them from settling into a solid mass. It renders the soap more soluble in kerosene. It may have some virtue as an insecticide; it may also be found a useful fungicide. Carbolic acid may prove dangerous to trees if used too strong, and may have to be cut down.

The most remarkable of all auxiliary emulsifiers is water. A small amount of water added to soap before the full amount of kerosene is added has a potent effect on the soluble oil. In certain cases, if a soluble oil be made by adding kerosene to the soap and carbolic acid merely, it may not be capable of forming any emulsion when thrown into water, separating into free kerosene; but if the proper amount of water be added to the soap before the kerosene is added, an excellent emulsion may be found. In fact all the

high ratios are obtained only by keeping the proper proportion between soap and water at the time the greater part of the kerosene is added. Without a proper amount of water in the soap none of the high ratio soluble oils will emulsify. Too much or too little water in the soap will prevent the formation of an emulsion, as readily as too much or too little carbolic acid. What is said in this respect relates not to the water added to the soluble oil in the way of manipulation, but to the making up of the soluble oil itself, for as just implied, water seems to be a necessary part of these high ratio soluble oils. This is not true of the low ratio soluble oils; with them a soap-carbolic-acid-kerosene mixture, water free, or nearly so, will give an emulsion, but if high ratio is desired water in the right proportion must be added.

For example in Formula 1, at the ratio of 5 to 1, calls for no water; but in Formula 4, which will permit as high a ratio as 25 to 1, water in a certain specified amount must be added to the carbolic acid soap mixture. This addition is made after the addition of a small quantity of kerosene, small relatively to what is to be added later, some kerosene being added to the hot mixture simply in order to bring about a solution. Now if the water were omitted a high ratio emulsion could not be secured, and if the water were added after all the kerosene there would likewise be failure. In this subject not only proportions must be observed, but also the order in which ingredients are added. Formula 4 may serve as an example. The menhaden oil, carbolic acid and potash are heated. If the resulting soap mixture is allowed to cool it will set to a solid mass, which will be slow in dissolving later in kerosene without aid of heat. Hence, to get the benefit of the heat without danger from fire, 1.4 gallons of kerosene is stirred into the hot mixture, thus a ready and safe solution being effected. Then 2.2 gallong of water is added, and there results, when cold, a dark red transparent liquid, a true solution of soap, kerosene, carbolic acid and water that may be poured into and mix readily with kerosene. Then or at any time later the proper amount of kerosene may be added to make the complete soluble oil, of the desired ratio. If desired, this can be kept in a concentrated form, prepared as just described, and the additional kerosene to make the ratio can be added by the user. By this means it could be shipped with great saving of freight, giving the use the proportion of kerosene he must add.

Thus in six gallons of the concentrated oil we would have

Actual Emulsifier (soap and carbolic acid)..	2.00 gallons.
Kerosene	1.56 gallons
Water	2.44 gallons
Total	6.00 gallons

Thus we would have in this six gallons an equivalent to 49 gallons of soluble oil of a ratio of 25 to 1. This barrel of soluble oil when diluted to 15 to 1 would make about 750 gallons of spray mixture, or at a ratio of 12 to 1, it would prepare one-half barrel of the soluble oil, or 375 gallons of spray mixture.

Soluble oils, when kept, sometimes separate into two layers of liquid, a lighter and a heavier, both of about the same color and general appearance. It is absolutely necessary that the mixture be uniform; if this were drawn off from top or bottom the proper proportions would be entirely destroyed. This happens sometimes with the proprietary oils sold on the market, if allowed to stand for sometime. If the bottom, or heavier, were drawn off, it would give an emulsion; but that from the top would not. Therefore, always mix thoroughly before drawing off any portion.

Soluble oils of high ratio are usually not clear, but slightly turbid. This does not interfere with their emulsifying power. The solubility of the soap—for it is a separation as a precipitate that causes the turbidity—depends upon the proportion between the carbolic acid and the kerosene, the more of the former relatively to the latter, the more soluble the soap.

Example.—In Formula 4, when enough kerosene is added to make the ratio 9 to 1 or a less ratio, there is a clear uniform solution; but at 10 to 1 it becomes barely turbid. As the ratio increases the turbidity increases also. Clear solutions can be obtained at these higher ratios by using more carbolic acid, but it often interferes with the emulsifying. If any slight turbidness is observed, simple agitation is all that is necessary to give excellent emulsions. It is always the best to keep all high ratio oils in the concentrated form as in Formula 4. Then mix up the soluble oil as wanted, as for example, enough to make one barrel of spray mixture. This amount would require for the 15 to 1 mixture (14 of water and one of soluble oil), 3½ gallons of soluble oil; and to make this at a 25 to 1 ratio, just about one pint of true emulsifier or 3 pints of the concentrated oil. Then, in brief, to make one barrel of 15 to 1 spray mixture at the ratio of 25 to 1, take 3 pints of the concentrated oil of Formula 4, add to it 3 gallons of kerosene, mix well and make up to an emulsion of one barrel. This new process soluble oils is a much better preparation than the old soap-kerosene emulsion made in the old way by boiling with water. Under this process the microscope showed the field densely crowded with uniform globules, whereas the emulsion made from soluble oils containing as much kerosene, showed but a small fraction of the number of globules. By the new process scarce one-hundredth part of the kerosene is visible. It is so finely divided as to be wholly invisible when magnified two hundred diameters.

DURABILITY.

The time a perfect emulsion will remain varies. Usually those made up from low ratio oils are much more lasting than those from the higher ratios. For practical purposes an emulsion that remains intact for a couple of hours is all that is necessary. Some made from the low ratio oils will last for several months. Most of the high ratio emulsions show a distinct oil layer on top after several hours or days. Good emulsion of 10 to 1 and even 20 to 1 last days and even weeks without showing free oil. Some will form a cream layer; this must not be mistaken for a free oil layer. The former is still an emulsion, the latter is not. The cream layer forms just as it does on milk, after standing; but the cream is easily mixed, while the free oil is more difficult. The more dilute the emulsion, that is the more water used to the gallon of soluble oil, the more quickly the cream rises.

The barrels in which these emulsions are made should be clean; also the sprayer tank, as almost all of the metal salts will decompose the soap and free oil will rise. Insecticidal and fungicidal preparations cannot be used with safety in connection with the oil emulsions. Bordeaux mixture, lime, sulphur and salt, copper sulphate, all decompose the soap and cause free oil to separate. Paris green seems to be the exception; this simply mixes with an emulsion and has no effect.

HOW TO MAKE THE EMULSIFIER.

The boiling can best be done in a covered iron kettle of double the size required for holding the liquid, since considerable room must be left for foaming. The arrangement should be such that the kettle can be removed quickly from the fire, since there might be danger of spoiling the product by over-heating. The heat should be regulated by a thermometer; it should read as high as 320 degrees Fahrenheit. The operation is simply to heat in the closely covered kettle the mixture of red oil, or menhaden oil, carbolic acid and potash, up to the specified temperature. This mixture is inflammable when hot; the operation should never be attempted inside or near a building. In the open air there is little risk; a smouldering fire is best. When the proper temperature is reached the kettle is removed from the fire and the soap is complete. The petroleum oils, either the full quota or only a portion, as may be specified, are added while the soap is hot, to facilitate solution, and if water is called for it is added. The concentrated oil is then ready for the remaining portion of petroleum oil to be added at once, or by the user as he desires. The best and safest method of cooking, where it can be done, is by steam, either through coils or in a steam jacket. A word of caution is here necessary in using

petroleum oils. Under no circumstances should they be brought near the fire in a building, and even outside, should it become necessary to heat them. The utmost caution must be used, as they are very inflammable.

FORMULAS.

Many formula for soluble oils might be given, but a few of the best are sufficient. These can be varied to different ratios, high or low, by the amount of kerosene added.

Formula No. 1:

Distilled red oil, 1 gallon.
Carbolic acid, 2 gallons.
Caustic potash 1 2-3 pounds.

Heat to 275-285 degrees Fahrenheit, then add

Kerosene, 18 gallons.
Ratio of kerosene to emulsifier, 6 to 1.
Cost of emulsifier per gallon, 41.5 cents.
Cost of emulsifying one gallon kerosene, 6.9 cents.
Cost of soluble oil per gallon, 13.2 cents.
Cost of spray mixture per 100 gallon, 88.0 cents.

The kerosene should be added to the mixture while hot (but after it is removed from the fire) to facilitate solution. Owing to the large proportion of carbolic acid this is rather a drastic mixture, but from this the amount can be increased, thus increasing the ratio, or it can be reduced to ratio of 5 to 1, by adding only 15 gallons of kerosene, or to 4 to 1, by adding only 12 gallons of kerosene.

Formula No. 2.

Distilled red oil, 1 gallon.
Carbolic acid, 2 gallons.
Caustic potash, 1 2-3 pounds.

Heat to 275-285 degrees Fahrenheit, then add

Kerosene, 21 gallons.

And after the mixture is cold add

Ammonia water, 26 degrees, 1-2 gallon.
Ratio of kerosene to emulsifier, 6 to 1.
Cost of emulsifier per gallon, 42.3 cents.
Cost of emulsifier one gallon kerosene, 7.0 cents.
Cost of soluble oil per gallon, 13.3 cents.
Cost of spray mixture per 100 gallons, 88.5 cents.

This is still more drastic than formula No. 1.

Formula No. 3.

This is a higher ratio, therefore not so drastic.

Distilled red oil, 1 gallon.
Carbolic acid, 0.6 gallon.
Caustic potash, 1 2-3 pounds.

Heat to 290-300 degrees Fahrenheit, then add

Kerosene, 5.0 gallons.

Water, 2.2 gallons.

Add finally kerosene, 19.0 gallons.

Ration of emulsifier, 15 to 1.

Cost of emulsifier, 43.7 cents.

Cost of emulsifying one gallon kerosene, 2.9 cents.

Cost of soluble oil, 10.6 cents.

Cost of spray mixture per 100 gallons, 70.7 cents.

The first portion of kerosene, 5 gallons, should be added at once to the hot mixture, then immediately the water. This forms the concentrated oil, which can be kept indefinitely in liquid form. To complete it as a soluble oil the 19 gallons more of kerosene is added. This preparation is very mild, as it contains no ammonia and scarcely more than one-third the amount of carbolic acid in Formula No. 1.

Formula No. 4.

Menhaden oil, 1 gallon.

Carbolic acid, 0.8 gallons.

Caustic potash, 1 2-3 pounds.

Heat to 290-300 Fahrenheit, then add

Kerosene, 1.4 gallons.

Water. 2.2 gallons.

This forms the concentrated oil.

When ready to make soluble oil add

Kerosene, 43.6 gallons.

Ratio kerosene to emulsifier, 25 to 1.

Cost of emulsifier, 40.4 cents.

Cost of emulsifier one gallon kerosene, 1.6 cents.

Cost of soluble oil per gallon, 9.7 cents.

Cost of spray mixture per 100 gallons, 64.7 cents.

The first portion kerosene, 1.4 gallons, should be added to the hot mixture, then the water. At this stage the preparation is a concentrated oil and may be kept in this state. As this is a high ratio soluble oil, that will not be clear and may have a tendency to separate, the remaining 43.6 gallons had better be added when ready to make the emulsion.

This is an extremely mild emulsion, the carbolic acid being only about one-eighth of one per cent.

The formula No. 4 in the concentrated form can be kept and used as a base for making either high or low ratio soluble oils, for instance to make a

20 to 1, add kerosene, 34.6 gallons.

15 to 1, add kerosene, 25.6 gallons.

10 to 1, add kerosene, 16.6 gallons.

5 to 1, add kerosene, 7.6 gallons.

Formula for crude oil might be given, but they are more difficult of manipulation, and have no advantage over kerosene, and add to the cost.

Formula 5.

Olive fig soap, 14 pounds.

Carbolic acid, 1 gallon.

Heat to 200-220 degrees Fahrenheit, then add

Kerosene, 2 gallons.

Water, 3 1-8 gallons.

The above constitutes the concentrated oil. Then add the remainder:

Kerosene, 44 gallons.

Ratio of kerosene to emulsifier, based on soap, 25 to 1.

Cost of emulsifier per gallon, 43.6 cents.

Cost of emulsifying one gallon kerosene, 2.4 cents.

Cost of soluble oil per gallon, 10.4 cents.

Cost of spray mixture per 100 gallons, 69.3 cents.

The soap and carbolic acid alone is heated; the two gallons of kerosene is added to keep the mixture in a fluid state. Always stir before using, as there is danger of separation in two layers. The water is indispensable to this ratio; the quantity of water must be closely measured, a trifle too much or too little may spoil the emulsion. This is the most uncertain preparation described.

Formula No. 6.

Emulsifier as made in Formula 5.

To the concentrated oil thus made add

Kerosene, 25.5 gallons.

Ratio of kerosene to emulsifier, 15 to 1.

The ratio can be raised or lowered by applying more or less kerosene to concentrated oil.

Formula No. 7.

Takanap soap, 5 pounds.

Kerosene, 10 gallons.

Stir vigorously, adding a little water from time to time. Then add water to make 100 gallons and agitate for five minutes. The result will be a rich creamy emulsion.

It does not require any particular skill to make the soluble oils. 10 or 20 gallons of the soap mixture, enough to make from 1 to 10 barrels of the soluble oil, according to the ratio, may easily be made in a covered cast iron kettle over a wood fire, in the open air.

The prices given for emulsions are based on the following prices:

Distilled red oil, 34 cents per gallon.

Menhaden, 29 cents per gallon.

Carbolic acid, 39 cents per gallon.

Ammonia water, 47 cents per gallon.
Kerosene, 8 1-2 cents per gallon.
Olive fig soap, 5 cents per pound.
Caustic potash, granulated, 7 1-2 cents per pound.

3. FUNGICIDES.

For preventing diseases of plants.

Fungi belongs to the vegetable kingdom. By the development of these parasitic fungi upon growing crops the peculiar maladies known as fungous diseases are produced. It is estimated that the loss to American agriculturists annually from fungus diseases amounts to hundreds of millions of dollars. It is probable that fruits suffer even greater proportionate injury than do the grains. The blights and rots of fruit plantations, the loss from apple scab, ranges from one-sixth to one-half of the entire product. The rot and mildew affecting the grapes have led to the extermination of hundreds of vineyards. The loss to peaches, plums, cherries, etc., throughout the country is enormous. Potatoes, vegetables of all kinds, flowers and ornamental plants, even shade trees, do not escape its ravages. Space will not permit entering into any lengthy descriptions further than has been given under other headings. The remedies, or rather the preventives, are what more directly interest us here.

Mechanical Exclusion—The spores can often be prevented from reaching the plant or fruit by protecting or covering, as in bagging grapes. The bag excludes the rot spores, thus keeping the fruit clean. The use of fungicides is the most practical way. The majority of them are applied externally by spraying or dusting. In such cases they act in either of both of two ways. 1st, by directly destroying any fungus spores present at the time of application, and 2nd, by remaining on the surface in a condition to destroy either before germination or during that process, any spores that may light upon the plant thereafter. Among the fungicides of the most practical value are the salts of copper. The one that is most extensively used is of French discovery, and is known under the name of Bordeaux mixture, containing 6 pounds sulphate of copper, 3 pounds of lime, 22 gallons of water. As we use it now it is much reduced. Bordeaux, No. 1.—Six pounds sulphate of copper, 4 pounds of lime, 50 gallons of water. Bordeaux, No. 2., has 4 pounds sulphate of copper, 6 pounds lime, 50 gallons of water; and for tender plants and trees a still weaker one is used. Two pounds sulphate of copper, 6 pounds lime, 50 gallons of water.

How it is made; a great deal of efficiency of this valuable mixture depends upon the method of its manufacture. If made as it should be, the ingredients remain suspended a long time, but as

it is generally made, they quickly settle to the bottom. A chemical change takes place. The sulphuric acid in the sulphate of copper passes over to the lime, forming the sulphate of lime (gypsum) and leaving the copper as a hydrate. These are mechanically suspended iu water. The gypsum being heavy, settles and carries the hydrated copper with it.

To make Bordeaux proper, three barrels are required. Put 25 gallons of water in one of these, and put 6 pouuds of sulphate of copper in a sack and suspend it in the water to dissolve. In another 4 pounds of lime is slaked in sufficient water, hot water is the best, then add sufficient water to make 25 gallons. Place a large sieve, 24 meshes to the inch, over the third barrel. Let two men dip, one, from the copper dissolved, the other from the milk of lime, aud pour simultaneously through the sieve, thus making 50 gallons of excellent Bordeaux. At the Paragon orchards I make a concentrated solution of the copper, and also of the lime, that each gallon of either represeuts one pound of the material. This is convenieut to mix at short uotice. Here, iustead of dipping and pouring, it is run by gravity. This mixture must be kept agitated while spraying, to keep the mixture well mixed and uniform. This can be used for any fungus disease until near ripening time of the fruit, when it must be discontinued, as it stains the fruit, and being insoluble is difficult to get off. After this fruit is half grown it is better to use either sulphate of copper, 2 1-2 ounces to 50 gallons of water, or copper acetate, 6 ounces to 50 gallous of water. For peach this is too strong; it will cause the foliage to drop. Four ounces to 50 gallons of water will be strong enough.

Copper Carbonate—Four ounces; dissolved in 3 pints of ammonia (26 Beaume), then adding to one barrel of water. The carbonate will dissolve more readily if mixed with water enough to form a paste, before it is added to the ammonia. This has beeu used successfully to prevent the apple scab, and various mildews. It is a simple fungicide, easy to make and apply; it is a clear solution, never clogs the nozzles. But it will cause foliage to drop from the peach. The better form for all delicate foliaged trees is

Copper carbonate, one pound made into a paste with water, then dilute to 50 gallons of water. This will not injure fruit or foliage. It is the ammonia in the former (ammoniated copper carbonate) that does the injury. There are many other excellent fungicides used for various purposes, such as potassium sulphide, used for red spider, which sometimes become very troublesome. This season, 1906, they were very bad on the apple and pear, causing the leaves to assume a dirty hue, and seriously interfering with the health of the tree and development of fruit.

Formula—Potash, 32 pounds; flower of sulphur, 37 pounds; salt, 2 pounds; water, 100 gallons. Mix the ingredients together in a large tank, with a little water, when chemical action will cause it to boil. Add balance of water. For spraying on foliage it should be diluted with 50 times as much water. In all sprays a great deal of the success or failure depends upon the purity of the ingredients, and the knowing how to handle them. Lime is a very variable commodity; some of the limes put upon the market contain more than 50 per cent. of magnesia; others contain a very small amount, so that when we purchase a lime of which we do not know the analysis, we are always uncertain of results. However, in the preparation of lime and sulphur wash, in using the ordinary formula there is a large surplus of lime. It is supposed the sulphide of lime is the agent that kills the scale, and one pound of lime is sufficient to combine with three pounds of sulphur, if the materials are pure. Now, supposing we use a magnesian lime, 50 per cent., and we use 40 pounds of lime to 30 pounds of sulphur, or one and one-third pounds to one of sulphur. If this four pounds contains but one-half pure lime it still leaves us two pounds to three pounds of sulphur, or two-thirds of one pound of lime to one pound of sulphur. And as it requires but one-third of one pound of lime to combine with one pound of sulphur to form the destroying agent, we still have a surplus of 50 per cent.; so I should think we are perfectly safe with ordinary lime. A lime that is but 75 per cent. pure will give us 10 pounds of pure lime, or sufficient to combine with 30 pounds of sulphur. All lime above what is actually necessary, is a useless, though harmless surplus, excepting that it makes the material so much more difficult to handle, clog nozzles, etc.

WHAT SPRAY SHALL WE USE?

We read of the many sprays, the successes and the failures; one scientist praising what another condemns; one says that lime, sulphur and salt is the sovereign remedy for San José Scale, another eminent scientist says petroleum is the ideal remedy; and beyond doubt both are right.

At the Paragon orchards, where the lime-sulphur wash is used, the scale are controlled, and the trees in the healthiest condition, insects and fungi at a minimum. An intelligent fruit raiser writes thus: "So long as I used crude oil, I could find very few insects. Then I tried lime, sulphur and salt wash, made with steam, and it appeared to be perfectly made; the trees were completely covered; I held the nozzle myself. Under this treatment the scale gained on us. I tried the K-L but did not find results satisfactory, although we had no difficulty in making a good mixture. I was entirely satisfied with the results of the crude oil, but it is expensive. Yet I shall continue its use."

Another intelligent grower used the crude oil on his apple and pear trees, being careful, manipulating the nozzles himself, with the result that over 75 per cent. of his trees were killed, and the balance were seriously injured.

Why this great difference in results? All are careful men, all love their calling; each one made and applied the remedies to the best of their ability.

First, lack of knowledge of the chemical action that takes place between the ingredients in the lime, sulphur and salt is often the true cause of failure. Having followed instructions which were in many instances none too plain, they failed to get the combination (the sulphide of lime). Time cannot be relied upon; color is the only safe guide. The residue should be carefully examined; if yellow sulphur remains in the barrel or kettle, more lime is needed in the mixture. If a residue of both lime and sulphur remains, longer boiling should be given. Only the sand and bits of rock or other impurities in the lime should remain.

Wherever the material was properly made and properly applied, at the proper time, success has always been sure. As a fungicide it has few equals.

Crude oil is not a fungicide, therefore not on par with lime and sulphur, which perform the dual purpose, but it is a sure remedy for the scale in careful hands, but a dangerous one in careless hands. Many failures are owing to three causes:

1.—Insufficient pressure, which should not be under 100 pounds.

2.—The nozzles are too coarse. throwing the oil in too coarse drops. The nozzle should be extremely fine, with the holes not larger in diameter than a fine cambric needle.

3.—The oil being too thick to pass through the fine nozzles, the operator often uses a coarse one, getting too much oil, often causing it to run down the limbs and trunk. The oil should be heated to a temperature of from 80 to 100 degrees (not over fire but by steam) when it flows smoothly under pressure, through a fine nozzle, into an extremely fine mist, putting a very light coat over the tree. The oil should be agitated to keep the light oil from separating from the heavier oil.

4.—Oil should be used only on a fine clear day, that evaporation will take place rapidly. The man who succeeds with oil takes note of all these small details. The man who does not, always fails.

DUST SPRAYS.

Dust sprays have been used in some form for many years, but only recently have they come into use on a large scale in orchards. On rough, hilly land they are extremely convenient, obviating the necessity of hauling water. The apparatus needed for their appli-

cation is light, and may be operated by a boy; and a light wagon drawn by one horse is all that is necessary. Their value has been tested at various experimental stations and are being used in many large orchards, with fairly satisfactory results, but its value is confined to fungus diseases, and as an insecticide for masticating insects. It is of no value for the various scale and sucking insects. The methods of preparing the material for dust spraying is as follows: Make the regular Bordeaux mixture, leave it stand 18 hours, pour off the liquid, and the sediment is put into a canvass sack, which is hung up to drain thoroughly. The sediment is then placed in shallow wooden boxes and exposed to the sun to dry. After drying, the lumps are put on a board and crushed until as fine as flour. Ten or 12 pounds of this stock preparation is mixed with 100 pounds of dry, slaked lime for spraying. To this Paris green should be added.

Another method: Dissolve 25 pounds copper sulphate in 11 gallons of boiling water, and sprinkle this over 3 bushels of good fresh stone lime. It will slake better if covered, to keep in steam. To this add 25 pounds flowers of sulphur and 5 pounds of Paris green, and the whole is put in a sifter. About one-half goes through. This portion contains the most Paris green and sulphur. The remainder is then reduced to powder and sifted and mixed with the other, when it is ready for spraying. The guide in these sprays should be 50 pounds of lime to each pound of copper, and each pound of Paris green.

SEASON FOR SPRAYING, AND HOW OFTEN, AND COST.

For the lime sulphur sprays, only while trees are dormant. Unless trees are very badly infested with scale, once each year is sufficient, but if scale are plentiful, spray in the Fall after leaves drop and again in the Spring before buds expand. The same rule will apply to the oils, always observing due precaution.

For codling moth and fungus diseases two or three times will be necessary for best results. Directions have been given under separate headings. But one thing remember; thoroughness is the key to success.

MACHINERY USED.

For the dust spray, there are several good machines, such as the Jumbo hand sprayer made by the Leggett Bros., of New York City; the Cyclone, made by the Dust Sprayer Manufacturing Co., of Kansas City, Mo.; The Universal, made by S. A. Haseltine, Springfield, Mo., and others. To spray a medium sized tree with dust spray will cost on an average about two cents per tree at each application. It will require two dust sprays to accomplish as much as one liquid spray.

Good spraying cannot be done against the wind, with dust or liquid spray. Spray thoroughly with wind; when wind changes or on a still day, spray the other side. A slight breeze favors good work.

SPRAY PUMPS.

The best is none too good; but a poor one is an injury to the cause. Nothing will disgust a man sooner than to try to use the L. S. S. mixture with a poorly constructed pump. What constitutes a good pump? It should be compact, setting low down on the tank, with all working parts near the bottom, with the plunger and cylinder submerged. It should be strong, with good leverage, easy to work, yet maintaining a high pressure. The piston working through a packing box is a nuisance, as it must be screwed so tight to prevent leakage, that they become man killers, and no man can keep up a uniform pressure of 80 pounds or more. A pump set on top of a barrel is objectionable, as it is top-heavy and always coming in contact with limbs. A pump with the plunger submerged never needs priming. It is always ready when you are. A pump is very short lived that takes its liquid through the plunger, especially if that liquid be lime, sulphur and salt. There should be no leather or rubber to make joints, valves and plungers tight. It should have a good agitator, one that keeps the liquid stirred from the bottom, as the tendency of most the spray material is to settle unless it is the oils, or oil emulsions.

There are several good hand sprayers on the market, and that is what is wanted by the small orchardist, having less than five acres. I used a hand spray pump for several years. Unfortunately my first one was one of those that try the muscle and the patience of the man. Generally my patience against the hired man's muscle. My second selection was the Eclipse, a machine that gave very excellent work. A cut of this machine is shown in Fig. 72. I used this pump for three years as a hand sprayer. As the orchard was increased in size, I felt the necessity of a power machine, so I purchased a two horse power double cylinder gasoline engine, mounted it on a low down wagon with a broad platform. Behind this I placed a 100 gallon tank. With this same Eclipse pump I had a scaffold built on the wagon with a pumping jack directly over the pump, to which it was attached by a rod, a belt run from the engine to the jack; this was geared back to run the pump 50 strokes to the minute. A safety relief valve was attached to relieve the pressure by permitting a portion to flow back into the tank if it went beyond 80 pounds pressure. This gave very good results, and I used this outfit two years. So the pump gave five years' service, three years by hand and two by power, and it is still in good condition. This

pump is manufactured by Morrill and Morley, Benton Harbor, Mich. There are several good pumps manufactured by others. The Goulds Manufacturing Co., Seneca Falls, N. Y.; The Century, manufactured by the Deming Co., Salem, O. These pumps are mounted on a barrel or tank; this can be placed on a wagon or sled, as desired. There are several power spray pumps, some run by gasoline engines, some by sprocket gearing attached to the rear wheels of the wagon, such as the Wallace, manufactured by the Wallace Sprayer Co., Champaign, Ill.; the Loop Compressed Air is an advance over the power sprayers.

The size of my orchard having outgrown the capacity of my machinery, I decided, if possible, to get the latest and best to be had. All the power machines had serious objections, being heavy and cumbersome, needing a great deal of attention, complicated parts to get out of order just at some critical time. My grounds being on a side hill made it difficult to travel among the trees with a top-heavy machine without danger of upsetting. Another serious objection with the majority, was the pump to be used at some stage either to force the material through the nozzles or to pump the air to condense it. The life of a pump being short at best, I wished to dispense with this expensive and unreliable part of the outfit. On investigation, I found but one that seemed to fill the bill, which, after a complete trial I purchased. The machine is shown in Fig. 69. This shows the machine at work in my orchard. Its simplicity is one of its strong points. It consists of a strongly made steel tank, fitted with the necessary connections for filling, agitating, admission of gas, etc. As will be observed, there is no pump connected, therefore no pumping to be done. The machine is operated by liquified carbonic gas, put up in 50 pound steel tubes, which, when empty, are refilled. Any pressure can be maintained from a few pounds up to 125 pounds, at which point a safety valve prevents higher pressure. All that is required to run the machine is to fill the tank with the mixture, close the opening, open the valve on the gas tube; when you have the pressure desired, close the valve and you are ready for work. The capacity of the machine is limited only by the number of lines of hose and nozzles you have at work, as it would run twenty nozzles as easily as it does one, for as fast as the spray material is driven from the tank, just that fast more power is generated.

Another strong feature of the Niagara sprayer is its nozzle protector, which strains all dirt or sediment from the mixture before it reaches the nozzles. This is one of the most valuable fixtures ever applied to a sprayer. Every one who has ever had any experience with sprayers knows how annoying it is to have the nozzles clogging every few minutes as is the case with lime, sulphur

and salt, especially if it becomes cold. Should this strainer become partially choked turn the strainer, and all the sediment collected is blown out of the machine and the screen is made perfectly clean.

The question is often asked, is this power not expensive? It may cost a little more than power taken out of the hired man, but then we have such a high, uniform pressure, throwing such a fine spray, that fully one-third more trees are sprayed with the same amount, thus saving more than enough to give the power for nothing. The gas cost me $1.75 for 50 pounds. This will spray about 700 gallons, costing for power one-fourth of a cent per gallon. One-third of the liquid saved makes 33 1-3 gallons at one and one-half cents per gallon, making one-half cent per gallon saved. So instead of being dearer, we get the power for nothing and save enough to pay the two men to operate it. The machine above described is the Niagara Gas Sprayer, manufactured by the Niagara Sprayer Co., Middleport, N. Y.

A few points of value to the orchardist:

Never have a hose shorter than 40 feet. I use nothing less than 50 feet. The hose sent out with all sprayers is from 8 feet to 20 feet; never longer. No man can spray a tree properly with a 20 foot hose. You are too close to the machine; you cannot get in suitable position to the tree; the wind is mostly unfavorable, and the hose does not allow you to shift your position. The team just stop exactly right or you cannot reach every portion of the tree. Then the wind may change, as it so frequently does when the weather man has it "winds variable'.' and the spray blows over the team and entire outfit. If you have a 50 foot hose, you have ample room. Use nothing but the best four-ply hose; it is the cheapest. est. I use one hose three to four years, dragging it over my stony land. It is safe; the cheap hose is never safe. They are liable to burst at any moment and a dose in the eyes will be long remembered. At the end of the hose you want an extension pole, 8 or 10 feet long, made of one-fourth inch brass or aluminum pipe, with bamboo covering. At the base or hose attachment is a leakless valve worked by a small lever that a partial turn with thumb or finger closes, thus saving the material. At the terminal end, a pair of good nozzles. This is sufficient. There may be times when four are better, but we seldom use more than two to one line of hose. For good work use the Vermorel nozzle.

How many acres can be sprayed per day? A year ago I saw a statement in a Western paper by a writer, that with a machine rigged with a sprocket gearing, with two lines of hose, with four nozzles each, two good mules, two men and one boy could spray from 60 to 100 acres good sized trees from 20 to 40 years old, in one day. Let us investigate. One acre planted 35 by 35 means 35 trees

per acre. One hundred acres would plant 3,500 trees. These trees, to be properly sprayed, would require 5 gallons per tree, or 16,500 gallons.

Let us see what the capacity of a good machine is. Under a pressure of 125 pounds, through eight instead of four nozzles, it will require 20 minutes continuous run to empty a 100 gallon tank. Now if this were kept up without intermission, or time to refill tank, for 12 hours per day, that would mean 300 gallons per hour, or 3,600 gallons per day, or less than one-fourth the amount claimed. Why editors allow such misleading statements to appear in their columns, I cannot see. There is no such outfit that can thoroughly spray over five to eight acres per day. The man who does more is one of those who fails to control the scale with lime, sulphur and salt washes, and whose apples are full of worms and covered with scabs. If you spray at all, do it intelligently. Know what you are spraying for, do it at the right time, use the right material, and apply it with care, endeavor to cover every portion of the tree or fruit. If these rules are faithfully carried out, you will be converted to the faith, and healthy trees and clean fruit will be your reward.

EXPLANATION OF TERMS USED IN THIS BULLETIN.

In treating of Horticulture and Agriculture, and the development of modern science, many terms are used that are new to the average reader. That a better understanding may be obtained, a list of those most used is here given, with their definitions.

TERMS USED IN CONNECTION WITH FERTILIZERS.

COMPLETE FERTILIZER—Is one that contains the three essential elements, nitrogen, phosphoric acid and potash.

NITROGEN exists in fertilizers in three distinct forms, viz., as organic matter, as ammonia and as nitrates. It is the most expensive ingredient used in fertilizers.

ORGANIC NITROGEN is nitrogen in combination with other elements, either animal or vegetable. The most valuable sources are, dried blood, dried meat, dried fish and cotton seed meal.

AMMONIA is a compound of nitrogen more readily available than organic nitrogen, as sulphate of ammonia it is the first product resulting from decaying vegetable or animal substances.

NITRATES, furnish the most readily available form of nitrogen, such as nitrate of soda, nitrate of potash, etc.

PHOSPHORIC ACID—One of the essential fertilizer ingredients, the one most used by cereals, and in the development of the seeds in all fruits, etc. It does not exist alone but in combination generally with lime, as in bones, rock phosphates, slag, etc. Phosphoric acid occurs in fertilizers in three forms—soluble, reverted and insoluble.

SOLUBLE PHOSPHORIC ACID is that form which is soluble in water and readily taken up by the plants.

REVERTED PHOSPHORIC ACID is that form which is insoluble in water, but which is acted upon by the other elements in the soil and rendered available for plant food.

AVAILABLE PHOSPHORIC ACID is the soluble and reverted taken together.

SUPER-PHOSPHATE is made by grinding the phosphate rock and treating it with sulphuric acid, which makes the phosphoric acid available; this is called acid phosphate.

POTASH—This essential element of plant food, or growth, was formerly derived principally from the ash of wood and vegetable matter, but is now obtained in large quantities from the potash mines of Stassfort, Germany. We have it in several forms, nitrate, muriate, sulphate and carbonate. The muriate and sulphate are the forms most used in compounding commercial fertilizers.

HUMUS is the name applied to decayed animal and vegetable matter. It is the principal source of nitrogen in the soil.

NITRIFICATION is the process of forming available nitrates from less active nitrogen of organic matter. It is due to the action of minute microscopic organisms.

MICRO ORGANISM is a plant or animal too small to be seen without the aid of compound microscope.

DENITRIFICATION is the process (due to micro-organisms), by which the available nitrogen is rendered less available, especially gasseous nitrogen.

BACTERIA is the name applied to a number of different microscopic organisms, all of which consist of single short cylindrical or eliptical cells, or two such cells joined end to end and capable of spontaneous movement. Many kind of bacteria are very injurious, destroying the living tissues of plants. Many others are our friends, such as those that enable leguminous plants to use free nitrogen of the air and those which give flavor to butter and cheese.

CULTURE is applied to bacteria or other organisms when they are produced under artificial conditions.

PURE CULTURE is a culture containing one kind of organism in the manufacture of any article and insures a uniform product.

FUNGUS—A very low form of plant life, destitute of green coloring matter; such as the different molds and mushrooms, very injurious to plant life.

SPORE is a minute body, borne by a fungus, which is capable of reproducing a fungus directly.

TERMS APPLIED TO PLANTS, TREES AND FRUITS.

CULM—The stem or straw of grain or grasses.

NODE—That part of the stem (usually somewhat enlarged and hardened as in grain or grasses) to which the leaves are attached.

INTERNODE—That part of the stem between the nodes.

CHLOROPHYL—The green coloring matter of plants.

PARTS OF THE FLOWER.

CALYX—The base or framework of the flower, usually green but sometimes colored.

COROLLA—Commonly called the petals of a flower; they are usually bright colored of various tints.

STAMEN—The part of the flower which produces pollen. Some flowers do not have these, they are the true female and self-sterile.

PISTIL—Is the ovule-bearing organ of the flower. It is the female organ.

STYLE—The middle portion or shaft of pistil connecting the stigma with germ.

STIGMA—The crown of the pistil which receives the pollen for the fecondation of the ovules.

OVULES—Are bodies when acted upon by the pollen become seeds.

POLLEN—A yellow or brown dust like substance, borne by the stamen, which when it comes in contact with the ovules borne within the pistil unite with them and pollenize the flower.

CROSS POLLINATION—Is the conveying of pollen from one variety of flower, to the pistil of another variety.

POLLINATION—Is the conveying pollen to the stigma, through the agency of insects, winds or artificial means.

FECUNDATION—Is the action of the pollen upon the ovules, rendering them capable of becoming seeds.

SELF-FERTILE—A flower possessing both the stamen and pistil and being capable of self fecundation.

SELF-STERILE—A flower being incapable of self-fecundation.

LEGUMES—Plants belonging to the order leguminosae, having the power to abstract nitrogen from the air through nodules on their roots, such as peas, beans, the clovers, etc.

TREE GROWTH.

ERECT—When the shoots rise nearly perpendicular.

DIVERGING—When they deviate from the perpendicular.

SPREADING—When they assume nearly the horizontal.

DROOPING—When the branches fall below the horizontal.

ASCENDING—When they curve upward.

IRREGULAR OR STRAGGLING—When they have no distinct form, but a mixture of the preceding.

LEAF FORMATION.

LEAVES—Are designated as, even, waved, wrinkled, flat, folded, narrow, erect, drooping, etc.

SERATE—Cut with teeth like a saw.

SHARPLY SERATE—When every serate ends with a sharp point.

DOUBLY SERATE—When the serates are again minutely serated.

CRENATE—When the teeth are rounded.

FRUIT FORMATION.

GLOBULAR—When the fruit is nearly round.

CONIC—A contraction from the transverse diameter toward the apex.

OBLONG—When the axis diameter appears the longest.

OVATE—Egg-shape, tapering at both ends.

OBLATE—Flattened, when the axial diameter is the shorter.

CYLINDRICAL—An oblong fruit, which is flattened at the ends.

DEPRESSED—Unusually flattened, oblate form.

PYRIFORM—Pear shape.

STRIPED—When alternating broad lines of color.

STREAKED—When the lines are long and narrow.

MARBLED—When the stripes are wide, faint, irregular or waving.

BLOCHED—Different abrupt shades, without any order or regularity.

CLOUDED—When the blotches are broader and more softly shaded.

SPLASHED—When the stripes are much broken and of all sizes.

MOTTLED—Covered with nearly confluent dots.

DOTTED—When these dots are more distinct.

SPOTTED—When the dots become larger.

BLOOM—A waxy, whitish substance covering the outside of the fruit.

TYPE—A group of fruit showing the same characters.

DRUPE—A fruit with one single hard seed, covered with flesh as the peach.

PUBESCENT—Downy, covered with down, like the peach or plum.

TOMENTOSE—Having a fine, matted wooly covering, especially applied to leaves.

LANATE—Woolly with long, soft hairs.

PERICARP—The outer covering, the skin.

SAROSCARP—The fleshy part of fruit, the edible part.

ENDOCARP—The stone covering the kernel.

POME—A fruit having a core, normally containing several seeds.

CAMBIUM—The soft, newly formed wood beneath the bark.

CORDATE—Heart-shaped.